7.2.1.   CPIEM Executable File

Cpiem.exe instantiates CPIEM and executes all procedures for CPIEM. The file handles the overall program flow and user interface.

7.2.2.   CPIEM Database

Key input tables within **Cpiem.mdb** are summarized for Level 1-2 in Table 7-2 and for Level 3 in Table 7-3. These tables are used to store user inputs for items such as population subgroup, concentration distributions, and indoor sources. Additional tables for Level 1-2 are used to store and match activity profiles for various integration periods. There is one table for each of the nine environments in Level 1-2. There are two tables for each of the six types of indoor sources in Level 3; two tables are needed because the inputs are relatively complex.

Although the data in many of the input tables are based directly on published data, in some instances calculations were required to convert the data to a form consistent with input requirements for CPIEM. These calculations are documented in Appendix C.

Table Name	Content
CL_POP	Case names and associated criteria for population subgroups
CL_BRT	Case names and associated inputs for breathing rates
CL_ENV<1 through 9>	Case names and associated inputs for concentration distributions for each of 9 micro environments: 1 for residence, 2 for office, 3 for industrial plant, 4 for school, 5 for travel in vehicle, 6 for public access building, 7 for restaurant/lounge, 8 for other indoor, or 9 for outdoors

Table 7-2 Level 1-2 Tables in CPIEM Database (Cpiem.mdb)

Note that each of the numbered tables (for example, CL_SRC1) contains the case names and indicates the record numbers in its correspondingly numbered "D" table (for example, CL_SRC1D), which contain the inputs for each case name.

Table Name	Content
CL_SRC1 and CL_SRC1D*	Case names and associated inputs for long-term (load factcr) indoor sources
CL_SRC2 and CL_SRC2D*	Case names and associated inputs for long-term (no loading) indoor sources
CL_SRC3 and CL_SRC3D*	Case names and associated inputs for episodic (load factor) indoor sources
CL_SRC4 and CL_SRC4D*	Case names and associated inputs for episodic (no load) indoor sources
CL_SRC5 and CL_SRC5D*	Case names and associated inputs for frequent (load factcr) indoor sources
CL_SRC6 and CL_SRC6D*	Case names and associated inputs for frequent (no load) indoor sources
CL_OUT1	Case names and associated inputs for daily outdoor concentrations
CL_OUT2	Case names and associated inputs for hourly outdoor concentrations
CL_PEN	Case names and associated inputs for penetration factors
CL_SNK	Case names and associated inputs for indoor sinks
CL_VOL	Case names and associated inputs for volumes
CL_ACH	Case names and associated inputs for air exchange rates

Note: tblPollutant table stores all pollutants used in both mcdels assigns an index/id number to each pollutant. All inputs saved by users for Level 1-2 concentration distributions and Level 3 indoor sources, outdoor concentrations, penetration factors, and indoor sinks are linked to the pollutant through this index/id number.

Table 7-3 Level 3 Tables in CPIEM Database (Cpiem.mdb)

7.2.3. Population Database and File

Pop.mdb contains information used to generate population subgroup cases. It contains input data tables for Level 1-2 Exposure/Doses integration periods.

Table Name	Content
WC_ACTAM	Input for exposure/doses for morning integration period
WC_ACTPM	Input for exposure/doses for afternoon integration period
WC_ACT1	Input for exposure/doses for 1 hour integration period
WC_ACT8	Input for exposure/doses for 8 hour integration period
WC_ACT24	Input for exposure/doses for 24 hour integration period

These files are used to determine characteristics of individuals to determine index numbers for activity profiles that match user criteria for population subgroup

7.3. Output Files

Output files are the results of each scenario run and are summarized for Level 1-2 in Table 7-5 and for Level 3 in Table 7-6. The files are of two types:

- Statistical summary files (.ste & .std for Level 1-2 and *.stc for Level3)
- Detailed (trial-by-trial) results (.prn for Level 1-2 and *.asc for Level3)

All output files are in ASCII format. Note that if you run the same scenario more than once (for example, using different parameters) without changing the name, CPIEM will overwrite the asc. and .stc files. To save the results from a series of runs, you can either change the name of the scenario for each run, or you can manually change the names of the .asc and .stc files after they are generated.

File Name	Content
Wc_act.act	Binary file with activity profiles for individuals that match user criteria for population subgroup. This file should not be changed or deleted.
<filename>.ste	Summary statistics for exposure distributions for each environment and total across environments
<filename>.std	Summary statistics for dose distributions for each environment and total across environments
<filename>.prn	Detailed (trial-by-trial) results for exposure and dose for each environment and total across environments

Table 7-4 Level 1-2 Output Files and Associated Contents

File Name	Content
<filename>.stc	Summary statistics for hourly-average and daily-average concentrations
<filename>.asc	Detailed (trial-by-trial) results for hourly-average and daily-average concentrations

* in which <filename> is the six character file name that CPIEM automatically assigns using the first 6 character of the associated scenario name.

Table 7-5 Level 3 Output Files and Associated Contents

7.4. Specifying an Output Directory

To better manage the output files are scenario runs, CPIEM provides an option for creating user specified output folders. This option can be exercised by selecting **Options** from the **Help** menu, and typing a folder name in the Output Folder field. Any existing directory or subdirectory may be specified. CPIEM will prompt the user if the folder does not already exist before creating a new one. **NOTE:** In order for a folder to be created under the root CPIEM directory, it may only be a single level of folder, i.e. "...\Cpiem\(folder1)" and not multiple levels such as "...\Cpiem\ (folder1)\(folder2) ". Otherwise, an error condition will be indicated, as follows.

7.5. Creating a Data Set files

Although most inputs to the model are in the form of parameters that describe distributions (e.g., normal, lognormal), data sets can also be provided for concentration inputs. A data set used by the model must be in a prescribed format. The Dataset.dbf (dBase III) file provides this format. Use this file as template when creating data set files. Several dataset files are also included in the installation set that can be used as examples.

When creating a .dbf file, it is recommended that data be added to a copy of the empty Dataset.dbf file, rather than editing a .dbf file containing data. To edit a copy of the given Dataset.dbf file(s), several different options are available that can be used based on user's preference and familiarity. The recommended tools are using a dBase file utility (e.g. dbMax), Access 9x or 2000 where the dbf file can be edited as an attached file, or earlier versions of Excel (e.g., 95), in the order listed.

7.6. Choosing a Random Number Generator Scheme

CPIEM 2.0 provides two schemes for generating random numbers, option A (default) and option B (for backward compatibility with the DOS version). See section 2.3.7 for more details.

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Appendix A:
Hardware Requirements and Software Installation

System Requirements

CPIEM has been designed to run with the following hardware and platform:

- Computer with Pentium microprocessor or higher.

- Hard disk with available capacity of 50 Mb or greater.

- VGA monitor or better.

- Microsoft Windows 95 or higher (98, NT, 2000)
  (CPIEM has not been installed or tested on Windows XP, but it should work as well on this new platform)

- Users who will be updating the database files will need Microsoft Access 97.

Installing CPIEM

The installation package on CD contains **CPIEM.CAB**, **SETUP.EXE**, and **SETUP.LST**. To install CPIEM:

1. Close all active computer programs or applications, except for Windows itself.

2. Double-click on **Setup.exe**.

3. CPIEM will open the CPIEM 2.0 Setup installation program. Follow the instructions given to install CPIEM.

4. Select the default directory "C:\Program Files\CPIEM" to install into, and click **OK**.

5. When you have finished making your selections, CPIEM will notify you that installation has been completed.

See Section 7 in the main document for a list and description of the installed files.

> **IMPORTANT NOTE:** Re-installing CPIEM would also install fresh copies of all application databases and data files that will over-write the existing CPIEM data. To preserve your data between installations, you would need to backup all files under "...\CPIEM\Data" directory by copying them to a different location. It is a good practice to archive your data periodically in any case. Once the re-installation is complete, you can copy the data back to this directory. A complete list of these data files is included in section 7.

Uninstalling CPIEM

To uninstall CPIEM, follow the same process as removing any other 32-bit windows application:

1. From the Start menu, open the Control Panel and Double-click on "Add/Remove Programs."

2. Select CPIEM application in the dialogue box and Click "Remove."

Re-installing CPIEM

If you are re-installing an upgrade version of CPIEM, you would need to un-install the application as described above prior to re-installing the new version.

Appendix B:
Input Data Provided with the Model

Level 1-2 Inputs

Inputs provided for Level 1-2 of the model describe concentration distributions for five types of environments—residence, office, school, travel in vehicle, and outdoors. Four other types of environments in the model—industrial plant, public access building, restaurant/lounge, and other indoor—currently have no inputs. The pollutants and integration periods for which input data are available are summarized in Table B-1. Some data are available for all pollutants in the model except total PAHs. The greatest amount of data is available for residences, followed by outdoors and travel in vehicle.

The concentration inputs for each type of environment are listed in Table B-2 for residences, B-4 for offices, B-5 for schools, B-6 for travel in vehicle, and B-7 for outdoors. Each listing indicates the case name by which the data are accessed in the model together with the pollutant, averaging period, and distribution type. Distributions for which data are provided are of four types: (1) normal, for which the arithmetic mean concentration and arithmetic standard deviation are listed (2) lognormal, for which the arithmetic mean concentration and arithmetic standard deviation are listed, (3) percentile, for which various percentiles of the cumulative frequency distribution are listed together with associated concentration values, and (4) data sets, for which the specific values are listed. Table B-3 provides recommended weights for the default cases for residences.

Table B-1 Summary of Concentration Data Available for Model Level 1-2

Pollutant	Residence (Envir 1)	Office (Envir 2)	School (Envir 4)	Travel in Vehicle (Envir 5)	Outdoors (Envir 9)
Benzene	24,A,P*	A	1	24,A,P	24,A,P
Benzo(a)pyrene	24,A,P	A	--	1	24,A,P
Carbon Monoxide	24	--	--	1,24	24
	24,A,P	--	--	24,A,P	24,A,P
Chloroform	24	24,A	--	1, 24	24
Formaldehyde	24	--	--	1	24,A,P
Nitrogen Dioxide	24,A,P	A	--	1	24,A,P
PM10	24,A,P	--	1	24,A,P	24
Perchlorethylene	--	--	--	--	--
Total PAHs	24,A,P	A	1	--	24,A,P
Trichloroethylene	24	--	--	--	--
Ozone	--	--	--	1	--
MTBE	--	--	--	1	--
1,3-Butadiene					

* 24 refers to a 24-hour integration period, A refers to a 12-hour daytime period, and P refers to a 12-hour nighttime period.

Table B-2 Concentration Distributions for Residences (Level 1-2)

Case Number	Case Name	Ref	Pollutant	Averaging Period	Distribution Type for Data
3	WOODSL[a]	1	Benzene	24	Lognormal(4.50,10.24)
4	WOODSP	1	Benzene	24	Percentile(0,0; 10,0.84; 25,1.50; 50,2.20; 75,4.80; 90,9.40; 100,130.00)
5	TM87B24L	2	Benzene	24	Lognormal(8.95,10.44)
6	TM87B24P	2	Benzene	24	Percentile(0,1.47; 5,1.64; 10,2.08; 25,3.41; 50,5.84; 75,9.84; 90,16.10; 95,31.70; 100,68.60)
7	TM87W24L[a]	2	Benzene	24	Lognormal(12.12,12.98)
8	TM87W24P	2	Benzene	24	Percentile(0,1.47; 5,1.72; 10,2.20; 25,4.56; 50,9.00; 75,14.25; 90,26.19; 95,48.56; 100,68.60)
9	TM87S24L[a]	2	Benzene	24	Lognormal(5.95,6.10)
10	TM87S24P	2	Benzene	24	Percentile(0,1.51; 5,1.55; 10,1.76; 25,2.72; 50,4.58; 75,7.56; 90,9.37; 95,20.93; 100,36.03)
11	TM87BDYL[a]	2	Benzene	AM	Lognormal(8.23,11.84)
12	TM87WDYL	2	Benzene	AM	Lognormal(10.97,15.70)
13	TM87SDYL	2	Benzene	AM	Lognormal(5.50,4.73)
14	TM87BNTL[a]	2	Benzene	PM	Lognormal(10.49,11.46)
15	TM87WNTL	2	Benzene	PM	Lognormal(14.56,13.31)
16	TM87SNTL	2	Benzene	PM	Lognormal(6.54,7.61)
17	TM84LAWL[a]	3	Benzene	PM	Lognormal(16.50,13.80)
18	TM84LASL[a]	3	Benzene	PM	Lognormal(7.78,9.26)
19	TM84CCSL[a]	3	Benzene	PM	Lognormal(6.47,8.31)
20	PTM24L	4	Benzo(a)Pyrene	24	Lognormal(.70,4.00)
21	PTMDYL	4	Benzo(a)Pyrene	AM	Lognormal(.52,2.52)
22	PTMNTL	4	Benzo(a)Pyrene	PM	Lognormal(.77,4.76)
23	WOODSP[a]	1	Chloroform	24	Percentile(0,0; 10,0; 25,0.20; 50,0.40; 75,1.20; 90,2.70; 100,4.00)
24	TM87B24L	2	Chloroform	24	Lognormal(1.31,1.58)
25	TM87B24P	2	Chloroform	24	Percentile(0,0.07; 5,0.07; 10,0.08; 25,0.34; 50,0.76; 75,1.70; 90,2.99; 95,5.44; 100,7.79)
26	TM87W24L[a]	2	Chloroform	24	Lognormal(1.41,1.52)
27	TM87W24P	2	Chloroform	24	Percentile(0,0.07; 5,0.08; 10,0.11; 25,0.34; 50,0.97; 75,1.79; 90,3.64; 95,5.10; 100,7.23)
28	TM87S24L[a]	2	Chloroform	24	Lognormal(1.20,1.65)

(continued)

Case Number	Case Name	Ref	Pollutant	Averaging Period	Distribution Type for Data
29	TM87S24P	2	Chloroform	24	Percentile(0,0.07; 5,0.07; 10,0.07; 25,0.34; 50,0.65; 75,1.28; 90,2.47; 95,6.75; 100,7.79)
30	TM87BDYL[a]	2	Chloroform	AM	Lognormal(1.27,1.45)
31	TM87WDYL	2	Chloroform	AM	Lognormal(1.38,1.48)
32	TM87SDYL	2	Chloroform	AM	Lognormal(1.13,1.41)
33	TM87BNTL[a]	2	Chloroform	PM	Lognormal(1.43,2.33)
34	TM87WNTL	2	Chloroform	PM	Lognormal(1.46,2.04)
35	TM87SNTL	2	Chloroform	PM	Lognormal(1.39,2.64)
36	TM84LAWL[a]	3	Chloroform	PM	Lognormal(2.17,2.01)
37	TM84LASL[a]	3	Chloroform	PM	Lognormal(1.57,3.39)
38	TM84CCSL[a]	3	Chloroform	PM	Lognormal(.80,1.58)
39	SEXMOBSL[b]	5a	Formaldehyde	24	Lognormal(111.70,84.70)
40	SEXMOBSP[b]	5a	Formaldehyde	24	Percentile(0,6.14; 6,30.70; 30,61.40; 53,92.00; 69,122.70; 84,184.10; 91,245.40; 96,368.10; 100,569.30)
41	SEXMOBWL[b]	5a	Formaldehyde	24	Lognormal(111.70,63.80)
42	SEXMOBWP[b]	5a	Formaldehyde	24	Percentile(0,20.90; 1,30.70; 20,61.40; 44,92.00; 69,122.70; 89,184.10; 96,245.40; 99,368.10; 100,385.30)
43	SEXCONWL[b]	5b	Formaldehyde	24	Lognormal(46.60,20.90)
44	SEXCONWP[b]	5b	Formaldehyde	24	Percentile(0,16.00; 10,24.50; 44,36.80; 57,49.10; 77,61.40; 91,73.60; 93,85.90; 99,98.20; 100,104.30)
45	ROGCONL[b]	6	Formaldehyde	24	Lognormal(61.10,25.80)
46	ROGCONP[b]	6	Formaldehyde	24	Percentile(0,22.10; 3,24.50; 13,36.80; 36,49.10; 63,61.40; 77,73.60; 86,85.90; 91,98.20; 94,110.40; 97,122.70; 100,147.20)
47	HARVLAL[c]	7	Nitrogen Dioxide	24	Lognormal(51.20,30.40)
48	HARVLAP[c]	7	Nitrogen Dioxide	24	Percentile(0,6.60; 5,13.40; 10,18.70; 25,31.30; 50,46.40; 75,65.80; 90,84.30; 95,100.90; 99,167.80; 100,289.40)
49	SOCLJNKL[b]	8	Nitrogen Dioxide	24	Lognormal(114.60,67.20)

(continued)

Case Number	Case Name	Ref	Pollutant	Averaging Period	Distribution Type for Data
50	SOCLJNKP[b]	8	Nitrogen Dioxide	24	Percentile(0,3.00; 5,34.50; 10,43.60; 25,65.20; 50,100.70; 75,147.90; 90,212.90; 95,244.70; 99,325.90; 100,390.80)
51	SOCLJNBL[b]	8	Nitrogen Dioxide	24	Lognormal(82.30,53.10)
52	SOCLJNBP[b]	8	Nitrogen Dioxide	24	Percentile(0,1.60; 5,23.30; 10,31.00; 25,47.80; 50,70.40; 75,104.50; 90,138.40; 95,168.60; 99,312.40; 100,390.80)
53	SOCLMRKL[b]	8	Nitrogen Dioxide	24	Lognormal(81.10,48.70)
54	SOCLMRKP[b]	8	Nitrogen Dioxide	24	Percentile(0,0; 5,21.00; 10,26.00; 25,40.00; 50,73.00; 75,110.00; 90,146.00; 95,167.00; 99,223.00; 100,330.00)
55	SOCLMRBL[b]	8	Nitrogen Dioxide	24	Lognormal(55.70,34.40)
56	SOCLMRBP[b]	8	Nitrogen Dioxide	24	Percentile(0,0; 5,15.00; 10,21.00; 25,31.00; 50,48.50; 75,72.00; 90,97.00; 95,121.00; 99,170.00; 100,247.00)
57	SOCLJLKL[b]	3	Nitrogen Dioxide	24	Lognormal(93.40,46.30)
58	SOCLJLKP[b]	8	Nitrogen Dioxide	24	Percentile(0,0.40; 5,26.90; 10,38.00; 25,60.80; 50,88.80; 75,122.60; 90,152.90; 95,171.20; 99,210.70; 100,260.60)
59	SOCLJLBL[b]	8	Nitrogen Dioxide	24	Lognormal(71.60,33.70)
60	SOCLJLBP[b]	8	Nitrogen Dioxide	24	Percentile(0,0.60; 5,23.30; 10,30.60; 25,47.30; 50,69.20; 75,91.80; 90,114.10; 95,127.50; 99,159.00; 100,203.00)
61	PTEAMFL[a]	4	Inhalable Particles (PM10)	24	Lognormal(79.00,51.40)
62	PTEAMFP	4	Inhalable Particles (PM10)	24	Percentile(0,19.90; 10,32.90; 25,45.10; 50,65.30; 75,106.40; 90,143.60; 100,324.80)
63	COLOMFL	9	Inhalable Particles (PM10)	24	Lognormal(42.50,21.90)
64	PTEAMFL[a]	4	Inhalable Particles (PM10)	AM	Lognormal(94.70,74.10)
65	PTEAMFL[a]	4	Inhalable Particles (PM10)	PM	Lognormal(62.70,40.90)
66	WOODSL[a]	1	Perchloroethylene	24	Lognormal(1.44,6.12)

(continued)

Case Number	Case Name	Ref	Pollutant	Averaging Period	Distribution Type for Data
67	WOODSP	1	Perchloroethylene	24	Percentile(0,0; 10,0; 25,0.12; 50,0.24; 75,0.73; 90,2.30; 100,30.00)
68	TM87B24L	2	Perchloroethylene	24	Lognormal(4.93,6.20)
69	TM87B24P	2	Perchloroethylene	24	Percentile(0,0.60; 5,0.69; 10,1.46; 25,2.24; 50,3.12; 75,4.95; 90,8.20; 95,17.67; 100,44.22)
70	TM87W24L[a]	2	Perchloroethylene	24	Lognormal(6.74,7.66)
71	TM87W24P	2	Perchloroethylene	24	Percentile(0,0.66; 5,1.19; 10,2.09; 25,2.99; 50,4.42; 75,7.12; 90,17.27; 95,21.90; 100,44.22)
72	TM87S24L[a]	2	Perchloroethylene	24	Lognormal(2.46,1.10)
73	TM87S24P	2	Perchloroethylene	24	Percentile(0,0.60; 5,0.62; 10,0.74; 25,1.84; 50,2.48; 75,2.88; 90,4.57; 95,4.71; 100,4.78)
74	TM87BDYL[a]	2	Perchloroethylene	AM	Lognormal(4.56,6.28)
75	TM87WDYL	2	Perchloroethylene	AM	Lognormal(5.86,7.96)
76	TM87SDYL	2	Perchloroethylene	AM	Lognormal(2.80,1.68)
77	TM87BNTL[a]	2	Perchloroethylene	PM	Lognormal(5.03,6.52)
78	TM87WNTL	2	Perchloroethylene	PM	Lognormal(7.71,7.72)
79	TM87SNTL	2	Perchloroethylene	PM	Lognormal(1.70,1.30)
80	TM84LAWL[a]	3	Perchloroethylene	PM	Lognormal(13.50,17.40)
81	TM84LASL[a]	3	Perchloroethylene	PM	Lognormal(3.99,11.20)
82	TM84CCSL[a]	3	Perchloroethylene	PM	Lognormal(3.36,5.57)
83	WOODSL[a]	1	Trichloroethylene	24	Lognormal(.65,1.57)
84	WOODSP	1	Trichloroethylene	24	Percentile(0,0; 10,0; 25,0.09; 50,0.19; 75,0.56; 90,1.90; 100,9.30)
85	TM87B24L	2	Trichloroethylene	24	Lognormal(1.01,1.49)
86	TM87B24P	2	Trichloroethylene	24	Percentile(0,0.06; 5,0.08; 10,0.16; 25,0.18; 50,0.39; 75,1.08; 90,3.38; 95,4.75; 100,7.27)
87	TM87W24L[a]	2	Trichloroethylene	24	Lognormal(.93,1.20)
88	TM87W24P	2	Trichloroethylene	24	Percentile(0,0.06; 5,0.06; 10,0.15; 25,0.18; 50,0.47; 75,1.24; 90,2.25; 95,4.60; 100,5.02)
89	TM87S24L[a]	2	Trichloroethylene	24	Lognormal(1.10,1.77)
90	TM87S24P	2	Trichloroethylene	24	Percentile(0,0.06; 5,0.13; 10,0.16; 25,0.18; 50,0.34; 75,0.90; 90,4.21; 95,6.55; 100,7.27)
91	TM87BDYL[a]	2	Trichloroethylene	AM	Lognormal(.87,1.31)
92	TM87WDYL	2	Trichloroethylene	AM	Lognormal(.99,1.35)
93	TM87SDYL	2	Trichloroethylene	AM	Lognormal(.72,1.27)

(continued)

Case Number	Case Name	Ref	Pollutant	Averaging Period	Distribution Type for Data
94	TM87BNTL[a]	2	Trichloroethylene	PM	Lognormal(1.37,2.65)
95	TM87WNTL	2	Trichloroethylene	PM	Lognormal(1.38,2.55)
96	TM87SNTL	2	Trichloroethylene	PM	Lognormal(1.35,2.80)
97	TM84LAWL[a]	3	Trichloroethylene	PM	Lognormal(3.97,8.15)
98	TM84LASL[a]	3	Trichloroethylene	PM	Lognormal(2.02,7.64)
99	TM84CCSL[a]	3	Trichloroethylene	PM	Lognormal(.76,1.00)
100	CRIAQALL[c]	10	Benzene	24	Lognormal(10.86,7.99)
101	CRIAQPGL[c]	10	Benzene	24	Lognormal(8.63,5.43)
102	CRIAQSCL[c]	10	Benzene	24	Lognormal(15.66,8.95)
103	CRIAQSDL[c]	10	Benzene	24	Lognormal(8.63,8.95)
104	CRIAQALL[c]	10	Nitrogen Dioxide	24	Lognormal(47.00,50.80)
105	CRIAQALP[c]	10	Nitrogen Dioxide	24	Percentile(0,0; 5,3.80; 25,16.90; 50,30.10; 75,60.20; 95,139.20; 100,332.90)
106	CRIAQPGL[c]	10	Nitrogen Dioxide	24	Lognormal(35.70,48.90)
107	CRIAQPGP[c]	10	Nitrogen Dioxide	24	Percentile(0,0; 5,0; 25,11.29; 50,20.69; 75,43.26; 95,142.96; 100,312.25)
108	CRIAQSCL[c]	10	Nitrogen Dioxide	24	Lognormal(64.00,58.30)
109	CRIAQSCP[c]	10	Nitrogen Dioxide	24	Percentile(0,0; 5,3.80; 25,28.20; 50,54.60; 75,82.80; 95,159.90; 100,332.90)
110	CRIAQSDL[c]	10	Nitrogen Dioxide	24	Lognormal(47.00,39.50)
111	CRIAQSDP[c]	10	Nitrogen Dioxide	24	Percentile(0,7.50; 5,11.30; 25,22.60; 50,30.10; 75,64.00; 95,118.50; 100,212.60)
112	CRIAQALL[c]	10	Carbon Monoxide	24	Lognormal(1.80,1.90)
113	CRIAQALP[c]	10	Carbon Monoxide	24	Percentile(0,0; 5,0.10; 25,0.80; 50,1.40; 75,2.10; 95,4.90; 100,14.80)
114	CRIAQPGL[c]	10	Carbon Monoxide	24	Lognormal(1.50,1.60)
115	CRIAQPGP[c]	10	Carbon Monoxide	24	Percentile(0,0; 5,0.10; 25,0.70; 50,1.00; 75,1.60; 95,3.80; 100,13.60)
116	CRIAQSCL[c]	10	Carbon Monoxide	24	Lognormal(3.10,2.70)
117	CRIAQSCP[c]	10	Carbon Monoxide	24	Percentile(0,0.30; 5,0.70; 25,1.40; 50,2.10; 75,3.70; 95,8.40; 100,14.80)
118	CRIAQSDL[c]	10	Carbon Monoxide	24	Lognormal(1.30,.90)
119	CRIAQSDP[c]	10	Carbon Monoxide	24	Percentile(0,0.10; 5,0.20; 25,0.70; 50,1.30; 75,1.60; 95,3.20; 100,4.90)

(continued)

Case Number	Case Name	Ref	Pollutant	Averaging Period	Distribution Type for Data
120	AVOLLA	22	Ozone	24	Percentile (1,0.0, 5, 0.0, 10, 0.0, 25, 3.93, 50, 11.78, 75, 31.41, 90, 62.82, 95, 82.45, 99, 98.16)
121	COLOCA[c]	23	Benzene	24	Percentile (1, 1.6, 5, 2.23, 25, 3.83, 50, 6.7, 75, 10.53, 95, 24.25, 100, 35.73)
122	COLOPGE[c]	23	Benzene	24	Percentile (1, 1.6, 5, 2.23, 25, 3.51, 50, 5.74, 75, 8.93, 95, 14.99, 100, 35.73)
123	COLOSD[c]	23	Benzene	24	Percentile(1, 1.91, 5, 3.19, 25, 3.83, 50, 5.42, 75, 8.29, 95, 14.67, 100, 33.5)
124	OFFECAAM	24	Benzo(a)pyrene	AM	Dataset (0.038, 0.036, 0.60, 0.13, 6.6)
125	PETEOZ	25	Ozone	24	Normal (25.52, 23.56)
126	PETEPM	25	PM10	24	Normal (40.6, 36.6)
127	PETEFM	25	Formaldehyde	24	Normal (11.3, 7.4)
128	OFFECAPM	24	Benzo(a)pyrene	PM	Dataset(0.018, 0.018, 0.20, 0.045, 0.20)
129	COLOSC[c]	23	Benzene	24	Percentile(1, 1.91, 5, 2.55, 25, 8.29, 50, 11.17, 75, 18.18, 95, 29.03, 100, 35.09)

a   Indicates case marked as default; see Table B-3 for recommended weights for default cases.

b   Data for these cases are based on week-long measurements. Although they are included among model inputs for the 24-hour averaging period, they are best treated as "practice" data sets.

c   Data for these cases are based on 48-hour measurements. Although they are included among model inputs for the 24-hour averaging period, they are best treated as "practice" data sets.

Table B-3 Recommended Weights (in Percents) for Default Cases for Residences

	24-Hour		Daytime		Nighttime	
	Case Name (#)	Weight	Case Name (#)	Weight	Case Name (#)	Weight
Benzene	WOODSL (3)	34	TM87BDYL (11)	100	TM87BNTL (14)	70
	TM87W24L (7)	33			TM84LAWL (17)	10
	TM87S24L (9)	33			TM84LASL (18)	10
					TM84CCSL (19)	10
Benzo(a)pyrene	PTM24L (20)	100	PTMDYL (21)	100	PTMNTL (22)	100
Carbon Monoxide	CRIAQALL (112)	100				
Chloroform	WOODSP (23)	34	TM87BDYL (30)	100	TM87BNTL (33)	70
	TM87W24L (26)	33			TM84LAWL (36)	10
	TM87S24L (28)	33			TM84LASL (37)	10
					TM84CCSL (38)	10
Formaldehyde	SEXMOBSL (39)	100				
Nitrogen Dioxide	HARVLAL (47)	100				
PM10	PTEAMFL (61)	100	PTEAMFL (64)	100	PTEAMFL (65)	100
Perchloroethylene	WOODSL (66)	34	TM87BDYL (74)	100	TM87BNTL (77)	70
	TM87W24L (70)	33			TM84LAWL (80)	10
	TM87S24L (72)	33			TM84LASL (81)	10
					TM84CCSL (82)	10
Trichloroethylene	WOODSL (83)	34	TM87BDYL (91)	100	TM87BNTL (94)	70
	TM87W24L (87)	33			TM84LAWL (97)	10
	TM87S24L (89)	33			TM84LASL (98)	10
					TM84CCSL (99)	10

Table B-4 Concentration Distributions for Offices (Level 1-2)

Case Number	Case Name	Ref	Pollutant	Averaging Period	Distribution Type
			Offices		
10	WOMBFM[a,c]	27	Formaldehyde	AM	Dataset (9.3, 1, 5.6, 7.9, 6.8, 16, 23, 19, 7.3, 8.5, 8.3, 12, 15, 17, 8.5, 6.1, 8.4, 3.9, 4.4, 5.4, 3.1, 3.3, 3.8, 8.4, 9.3 10,5.2, 5.7, 5.3,17, 21, 21, 8.4, 12, 8.5, 21, 29, 27, 9.2, 11,11, 13, 13, 14, 15, 16, 15)
4	ROGOL[b]	6	Formaldehyde	24	Lognormal (41.20,15.60)
5	TURKL[b]	11	Formaldehyde	24	Lognormal (28.20, 12.40)
6	DAISBEN[c]	26	Benzene	AM	Lognormal (1.6, 2.08)
7	DAISTRI[c]	26	Trichloroethylene	AM	Lognormal (2.46, 2.28)
8	OFFEBAP	24	Benzo(a)pyrene	AM	Dataset (0.044, 0.38)
9	WOMBPM[a,c]	27	PM10	AM	Dataset (13, 4.7,6.2,11, 12, 19, 11, 15, 18, 11, 15, 18, 11,11,12, 8.5,12, 9.6, 12,13, 13, 13, 11, 12, 6, 6.9, 7.1, 9.1, 6.7, 7.4, 8, 9, 12, 31, 5.3, 7.4, 9.3, 13, 24, 29, 16, 14, 16, 15, 15, 12)

a Indicates case marked as default. See Table B-4a for recommended weights for default cases.

b Data for these cases are based on biweekly measurements. Although they are included among model inputs for the 24-hour averaging period, they are not recommended for use as model inputs for the 24-hour averaging period. Any modeling results using this data should be interpreted with caution.

c Data for these cases are based on 8-hour daytime average measurements, but are appropriate for use as model inputs for the AM (12-hour daytime) averaging period in the office environment.

Table B-4a Recommended Weights (in Percents) for Default Cases for Offices

	24-Hour		Day Time	
	Case Name (#)	Weight	Case Name (#)	Weight
Formaldehyde	WOMBFM(10)	100	WOMBFM(10)	100
PM10	WOMBPM(9)	100	WOMBPM(9)	100

Table B-5 Concentration Distributions for Schools (Level 1-2)

Case Number	Case Name	Ref	Pollutant	Averaging Period	Distribution Type
			Schools		
4	UNDEBEN [a,b]	28	Benzene	1	Dataset (3.19, 4.79, 8.93, 12.12, 2.55, 3.83, 9.57, 9.57, 1.6, 1.91, 4.79, 4.79, 3.83, 4.79, 2.87)
5	UNDETET [a,b]	28	Perchlorethylene	1	Dataset (0.34, 0.41, 0.81, 0.81, 0.61, 0.68, 0.81, 0.88, 0.68, 0.75, 0.81, 1.02, 1.49, 2.99, 3.12)
6	UNDETRI [a,b]	28	Trichloroethylene	1	Dataset (1.94, 1.61, 2.31, 2.53, 15.01, 14.15, 12.85, 12.59)

(California Portable Classrooms Study data will be available in 2003)

[a] There are no appropriate default data available for schools. Data from the California Portable Classrooms Study will be available in 2003.

[b] Data for these cases are based on 30-minute average measurements. Although they are included among model inputs for the 1-hour averaging period, they are of limited use as model inputs for the 1-hour averaging period. Any modeling results using this data should be interpreted with caution.

Table B-6 Concentration Distributions for Travel in Vehicle (Level 1-2)

			Travel in Vehicle		
Case Number	Case Name	Ref	Pollutant	Averaging Period	Distribution Type
18	RODEBUTA[a]	29	1,3-Butadiene	1	Dataset – see Appendix H in reference 29
19	RODEMTBE[a]	29	MTBE	1	Dataset – see Appendix H in reference 29
20	RODEFORM[a]	29	Formaldehyde	1	Dataset – see Appendix H in reference 29
21	RODEPM10[a]	29	PM10	1	Dataset – see Appendix H in reference 29
22	RODECO[a]	29	Carbon Monoxide	1	Dataset – see Appendix H in reference 29
25	RODEBENZ[a]	29	Benzene	1	Dataset – see Appendix H in reference 29
26	RODEBUTA[a]	29	1,3-Butadiene	24	Dataset – see Appendix H in reference 29
27	RODEMTBE[a]	29	MTBE	24	Dataset – see Appendix H in reference 29
28	RODEFORM[a]	29	Formaldehyde	24	Dataset – see Appendix H in reference 29
28	RODEPM10[a]	29	PM10	24	Dataset – see Appendix H in reference 29
30	RODECO[a]	29	Carbon Monoxide	24	Dataset – see Appendix H in reference 29
31	RODEBENZ[a]	29	Benzene	24	Dataset – see Appendix H in reference 29
3	SHIKL[b]	12	Benzene	24	Lognormal (42.50,30.70)
4	SHIKL[b]	12	Benzene	AM	Lognormal (42.50,30.70)
5	SHIKL[b]	12	Benzene	PM	Lognormal (42.50,30.70)
6	SHIKL[b]	12	Chloroform	24	Lognormal (0.44,0.15)
7	SHIKL[b]	12	Chloroform	AM	Lognormal (0.44,0.15)
8	SHIKL[b]	12	Chloroform	PM	Lognormal (0.44,0.15)
9	SHIKL[b]	12	Formaldehyde	24	Lognormal (15.30,6.40)
10	SHIKL[b]	12	Perchloroethylene	24	Lognormal (37.30,32.60)
11	SHIKL[b]	12	Perchloroethylene	AM	Lognormal (37.30,32.60)
12	SHIKL[b]	12	Perchloroethylene	PM	Lognormal (37.30,32.60)
14	SHIKL[b]	12	Carbon monoxide	24	Lognormal (9.90,5.70)

[a] Defaults based on measurements in Los Angeles and Sacramento. See Table B-6a for recommended weights for default cases.

[b] Los Angeles data from 1987. Concentrations are high compared to 1997 study of Rodes et al, due to changes in emissions and roadways over time.

Table B-6a Recommended Weights (in Percents) for Default Cases for Travel in Vehicle

	1-Hour		24-Hour	
	Case Name (#)	Weight	Case Name (#)	Weight
Carbon Monoxide	RODECO (22)	100	RODECO (30)	100
Formaldehyde	RODEFORM (20)	100	RODEFORM (28)	100
PM10	RODEPM10 (21)	100	RODEPM10 (29)	100
1,3 Butadiene	RODEBUTA (18)	100	RODEBUTA (26)	100
MTBE	RODEMTBE (19)	100	RODEMTBE (27)	100
Benzene	RODEBENZ (25)	100	RODEBENZ (31)	100

Table B-7 Concentration Distributions for Outdoors (1-2)

Case Number	Case Name	Ref	Pollutant	Averaging Period	Distribution Type (Data)
			Outdoors		
3	TXNETALL	13	Benzene	24	Lognormal (8.04,6.78)
4	TXNETSCL	13	Benzene	24	Lognormal (10.20,7.07)
5	TXNETSFL	13	Benzene	24	Lognormal (7.27,6.48)
6	TXNETRSL	13	Benzene	24	Lognormal (7.46,5.83)
7	WOODOUTL	1	Benzene	24	Lognormal (1.20,0.62)
8	TM87B24L	2	Benzene	24	Lognormal (5.10,3.46)
9	TM87W24L	2	Benzene	24	Lognormal (6.41,3.83)
10	TM87S24L	2	Benzene	24	Lognormal (3.75,2.41)
11	TM84LAWL	3	Benzene	PM	Lognormal (18.90,9.11)
12	TM84LASL	3	Benzene	PM	Lognormal (3.07,2.16)
13	TM84CCSL	3	Benzene	PM	Lognormal (1.82,1.01)
14	TM87BDYL	2	Benzene	AM	Lognormal (4.10,2.81)
15	PTM24L	4	Benzo(a)Pyrene	24	Lognormal (0.30,0.36)
16	PTMDYL[a]	4	Benzo(a)Pyrene	AM	Lognormal (0.17,0.26)
17	PTMNTL[a]	4	Benzo(a)Pyrene	PM	Lognormal (0.44,0.51)
18	TXNETALL	13	Chloroform	24	Lognormal (0.19,0.59)
19	TXNETSCL	13	Chloroform	24	Lognormal (0.18,0.16)
20	TXNETSFL	13	Chloroform	24	Lognormal (0.17, 0.14)
21	TXNETRSL	13	Chloroform	24	Lognormal (0.21,0.86)
22	TM87B24L	2	Chloroform	24	Lognormal (0.64,1.11)
23	TM87W24L	2	Chloroform	24	Lognormal (0.49,0.80)
24	TM87S24L	2	Chloroform	24	Lognormal (0.79,1.36)
25	TM84LAWL	3	Chloroform	PM	Lognormal (1.14,1.86)
26	TM84LASL	3	Chloroform	PM	Lognormal (0.35,0.58)
27	TM84CCSL	3	Chloroform	PM	Lognormal (0.59,0.47)
28	TXNETALL	13	Benzo(a)Pyrene	24	Lognormal (0.84,1.87)
29	TXNETSCL	13	Benzo(a)Pyrene	24	Lognormal (0.42,0.74)
30	TXNETSFL	13	Benzo(a)Pyrene	24	Lognormal (0.54,0.88)
31	TXNETRSL	13	Benzo(a)Pyrene	24	Lognormal (1.03,2.02)
32	TOXALL	13	Formaldehyde	24	Lognormal (4.00,3.20)
33	TOXSCL	13	Formaldehyde	24	Lognormal (4.60,3.70)
34	TOXSFL	13	Formaldehyde	24	Lognormal (3.20,2.40)
35	TOXRSL	13	Formaldehyde	24	Lognormal (3.60,2.70)
36	HARVLAL[a,c]	7	Nitrogen Dioxide	24	Lognormal (72.00,39.30)
37	SOCLJANL[b]	8	Nitrogen Dioxide	24	Lognormal (107.00,42.50)
38	SOCLMARL[b]	8	Nitrogen Dioxide	24	Lognormal (53.70,22.60)
39	SOCLJULL[b]	8	Nitrogen Dioxide	24	Lognormal (77.20,34.20)
40	TXNETALL	13	Inhalable Particles (PM10)	24	Lognormal (38.60,34.60)
41	TXNETSCL	13	Inhalable Particles (PM10)	24	Lognormal (51.60,37.20)
42	TXNETSFL	13	Inhalable Particles (PM10)	24	Lognormal (30.70,24.80)
43	TXNETRSL	13	Inhalable Particles (PM10)	24	Lognormal (37.00,34.90)
44	PTEAMFL[a]	4	Inhalable Particles (PM10)	24	Lognormal (91.20,50.70)
45	PTEAMFL[a]	4	Inhalable Particles (PM10)	AM	Lognormal (94.90,70.60)
46	PTEAMFL[a]	4	Inhalable Particles (PM10)	PM	Lognormal (86.30,56.00)
47	TXNETALL	13	Perchloroethylene	24	Lognormal (2.18,3.89)

(continued)

			Outdoors		
Case Number	Case Name	Ref	Pollutant	Averaging Period	Distribution Type (Data)
48	TXNETSCL	13	Perchloroethylene	24	Lognormal (3.78,7.08)
49	TXNETSFL	13	Perchloroethylene	24	Lognormal (2.14,2.14)
50	TXNETRSL	13	Perchloroethylene	24	Lognormal (1.40,1.65)
51	WOODOUTL	1	Perchloroethylene	24	Lognormal (0.53,1.99)
52	TM87B24L	2	Perchloroethylene	24	Lognormal (2.90,2.55)
53	TM87W24L	2	Perchloroethylene	24	Lognormal (4.06,3.08)
54	TM87S24L	2	Perchloroethylene	24	Lognormal (1.75,0.99)
55	TM84LAWL	3	Perchloroethylene	PM	Lognormal (11.20,9.80)
56	TM84LASL	3	Perchloroethylene	PM	Lognormal (1.86,1.34)
57	TM84CCSL	3	Perchloroethylene	PM	Lognormal (0.62,1.26)
58	TXNETALL	13	Trichloroethylene	24	Lognormal (0.87,2.02)
59	TXNETSCL	13	Trichloroethylene	24	Lognormal (0.96,1.07)
60	TXNETSFL	13	Trichloroethylene	24	Lognormal (1.01,3.08)
61	TXNETRSL	13	Trichloroethylene	24	Lognormal (0.70,1.39)
62	TM87B24L	2	Trichloroethylene	24	Lognormal (0.16,0.14)
63	TM87W24L	2	Trichloroethylene	24	Lognormal (0.21,0.18)
64	TM87S24L	2	Trichloroethylene	24	Lognormal (0.11,0.05)
65	TM84LAWL	3	Trichloroethylene	PM	Lognormal (0.95,0.78)
66	TM84LASL	3	Trichloroethylene	PM	Lognormal (0.14,0.34)
67	TM84CCSL	3	Trichloroethylene	PM	Lognormal (0.12, 0.06)
68	CRIAQALL[c]	10	Benzene	24	Lognormal (8.63,7.99)
69	CRIAQPGL[c]	10	Benzene	24	Lognormal (5.43,3.20)
70	CRIAQSCL[c]	10	Benzene	24	Lognormal (15.02,11.18)
71	CRIAQSDL[c]	10	Benzene	24	Lognormal (6.07,2.56)
72	CRIAQALL[c]	10	Nitrogen Dioxide	24	Lognormal (43.30,32.00)
73	CRIAQPGL[c]	10	Nitrogen Dioxide	24	Lognormal (33.90,24.50)
74	CRIAQSCL[c]	10	Nitrogen Dioxide	24	Lognormal (65.80,41.40)
75	CRIAQSDL[c]	10	Nitrogen Dioxide	24	Lognormal (39.50,22.60)
76	CRIAQALL[a,c]	10	Carbon Monoxide	24	Lognormal (1.10,1.40)
77	CRIAQPGL[c]	10	Carbon Monoxide	24	Lognormal (0.80,0.60)
78	CRIAQSCL[c]	10	Carbon Monoxide	24	Lognormal (2.20,2.30)
79	CRIAQSDL[c]	10	Carbon Monoxide	24	Lognormal (0.80,0.60)
80	TM87WDYL	2	Benzene	AM	Lognormal (4.69,3.07)
81	TM87SDYL	2	Benzene	AM	Lognormal (3.45,2.38)
82	TM87BNTL	2	Benzene	PM	Lognormal (6.97,6.06)
83	TM87WNTL	2	Benzene	PM	Lognormal (9.58,6.83)
84	TM87SNTL	2	Benzene	PM	Lognormal (3.96,2.98)
85	TM87BDYL	2	Chloroform	AM	Lognormal (0.63,1.57)
86	TM87WDYL	2	Chloroform	AM	Lognormal (0.48,0.77)
87	TM87SDYL	2	Chloroform	AM	Lognormal (0.80,2.12)
88	TM87BNTL	2	Chloroform	PM	Lognormal (0.74,1.83)
89	TM87WNTL	2	Chloroform	PM	Lognormal (0.47,1.10)
90	TM87SNTL	2	Chloroform	PM	Lognormal (1.05,2.39)
91	TM87BDYL	2	Perchloroethylene	AM	Lognormal (2.61,1.83)
92	TM87WDYL	2	Perchloroethylene	AM	Lognormal (2.94,1.84)
93	TM87SDYL	2	Perchloroethylene	AM	Lognormal (2.26,1.77)

(continued)

			Outdoors		
Case Number	Case Name	Ref	Pollutant	Averaging Period	Distribution Type (Data)
94	TM87BNTL	2	Perchloroethylene	PM	Lognormal (3.64,4.39)
95	TM87WNTL	2	Perchloroethylene	PM	Lognormal (5.72,5.12)
96	TM87SNTL	2	Perchloroethylene	PM	Lognormal (1.24,0.87)
97	TM87BDYL	2	Trichloroethylene	AM	Lognormal (0.13,0.12)
98	TM87WDYL	2	Trichloroethylene	AM	Lognormal (0.16,0.15)
99	TM87SDYL	2	Trichloroethylene	AM	Lognormal (0.11,0.07)
100	TM87BNTL	2	Trichloroethylene	PM	Lognormal (0.20,0.23)
101	TM87WNTL	2	Trichloroethylene	PM	Lognormal (0.28,0.29)
102	TM87SNTL	2	Trichloroethylene	PM	Lognormal (0.12,0.10)
103	CABENZ97	30	Benzene	24	Lognormal (1.86,2.16)
104	CABENZ98	30	Benzene	24	Lognormal (1.87,1.97)
105	CABENZ99	30	Benzene	24	Lognormal (1.68,2.07)
106	CABENZ[a]	30	Benzene	24	Lognormal (1.82,2.08)
107	OABENZ97	30	Benzene	24	Lognormal (1.19,1.34)
108	OABENZ98	30	Benzene	24	Lognormal (1.17,1.08)
109	OABENZ99	30	Benzene	24	Lognormal (1.22,1.38)
110	OABENZ	30	Benzene	24	Lognormal (1.20,1.27)
111	SFBENZ97	30	Benzene	24	Lognormal (1.76,174)
112	SFBENZ98	30	Benzene	24	Lognormal (1.87,1.75)
113	SFBENZ99	30	Benzene	24	Lognormal (2.04,2.37)
114	SFBENZ	30	Benzene	24	Lognormal (1.84,1.82)
115	SCBENZ97	30	Benzene	24	Lognormal (2.63,2.13)
116	SCBENZ98	30	Benzene	24	Lognormal (2.62,2.46)
117	SCBENZ99	30	Benzene	24	Lognormal (2.43,2.69)
118	SCBENZ	30	Benzene	24	Lognormal (2.59,2.43)
119	CABAP97	30	Benzo(a)pyrene	24	Lognormal (0.15,0.30)
120	CABAP98	30	Benzo(a)pyrene	24	Lognormal (0.18,0.39)
121	CABAP99	30	Benzo(a)pyrene	24	Lognormal (0.14,0.28)
122	CABAP[a]	30	Benzo(a)pyrene	24	Lognormal (0.16,0.32)
123	OABAP97	30	Benzo(a)pyrene	24	Lognormal (0.18,0.45)
124	OABAP98	30	Benzo(a)pyrene	24	Lognormal (0.24,0.65)
125	OABAP99	30	Benzo(a)pyrene	24	Lognormal (0.17,0.42)
126	OABAP	30	Benzo(a)pyrene	24	Lognormal (0.20,0.50)
127	SFBAP97	30	Benzo(a)pyrene	24	Lognormal (0.10,0.16)
128	SFBAP98	30	Benzo(a)pyrene	24	Lognormal (0.16,0.30)
129	SFBAP99	30	Benzo(a)pyrene	24	Lognormal (0.12,0.20)
130	SFBAP	30	Benzo(a)pyrene	24	Lognormal (0.12,0.22)
131	SCBAP97	30	Benzo(a)pyrene	24	Lognormal (0.15,0.27)
132	SCBAP98	30	Benzo(a)pyrene	24	Lognormal (0.14,0.24)
133	SCBAP99	30	Benzo(a)pyrene	24	Lognormal (0.14,0.23)
134	SCBAP	30	Benzo(a)pyrene	24	Lognormal (0.14,0.25)
135	CACHL97	30	Chloroform	24	Lognormal (0.19,0.21)
136	CACHL98	30	Chloroform	24	Lognormal (0.15,0.15)
137	CACHL99	30	Chloroform	24	Lognormal (0.25,0.04)
138	CACHL[a]	30	Chloroform	24	Lognormal (0.20,0.19)
139	OACHL97	30	Chloroform	24	Lognormal (0.29,0.14)

(continued)

Outdoors					
Case Number	Case Name	Ref	Pollutant	Averaging Period	Distribution Type (Data)
140	OACHL98	30	Chloroform	24	Lognormal (0.25,0.03)
141	OACHL99	30	Chloroform	24	Lognormal (0.25,0.03)
142	OACHL	30	Chloroform	24	Lognormal (0.27,0.09)
143	SFCHL97	30	Chloroform	24	Lognormal (0.09,0.08)
144	SFCHL98	30	Chloroform	24	Lognormal (0.07,0.04)
145	SFCHL99	30	Chloroform	24	Lognormal (0.25,0.03)
146	SFCHL	30	Chloroform	24	Lognormal (0.09,0.08)
147	SCCHL97	30	Chloroform	24	Lognormal (0.25,0.02)
148	SCCHL98	30	Chloroform	24	Lognormal (0.25,0.04)
149	SCCHL99	30	Chloroform	24	Lognormal (0.26,0.06)
150	SCCHL	30	Chloroform	24	Lognormal (0.25,0.04)
151	CAFORM97	30	Formaldehyde	24	Lognormal (4.85,4.31)
152	CAFORM98	30	Formaldehyde	24	Lognormal (5.22,4.83)
153	CAFORM99	30	Formaldehyde	24	Lognormal (5.29,4.60)
154	CAFORM[a]	30	Formaldehyde	24	Lognormal (5.13,4.60)
155	OAFORM97	30	Formaldehyde	24	Lognormal (5.03,5.16)
156	OAFORM98	30	Formaldehyde	24	Lognormal (5.00,4.66)
157	OAFORM99	30	Formaldehyde	24	Lcgnormal (4.19,3.32)
158	OAFORM	30	Formaldehyde	24	Lognormal (4.74,4.36)
159	SFFORM97	30	Formaldehyde	24	Lognormal (2.34,1.44)
160	SFFORM98	30	Formaldehyde	24	Lognormal (2.30,1.81)
161	SFFORM99	30	Formaldehyde	24	Lognormal (2.61,2.07)
162	SFFORM	30	Formaldehyde	24	Lognormal (2.40,1.76)
163	SCFORM97	30	Formaldehyde	24	Lognormal (5.38,3.54)
164	SCFORM98	30	Formaldehyde	24	Normal (5.80,3.27)
165	SCFORM99	30	Formaldehyde	24	Lognormal (6.59,4.89)
166	SCFORM	30	Formaldehyde	24	Lognormal (6.06,4.41)
167	CATETR97	30	Perchloroethylene	24	Lognormal (0.78,0.96)
168	CATETR98	30	Perchloroethylene	24	Lognormal (0.70,0.86)
169	CATETR99	30	Perchloroethylene	24	Lognormal (0.76,0.68)
170	CATETR[a]	30	Perchloroethylene	24	Lognormal (0.74,0.88)
171	OATETR97	30	Perchloroethylene	24	Lognormal (0.46,0.24)
172	OATETR98	30	Perchloroethylene	24	Lognormal (0.42,0.18)
173	OATETR99	30	Perchloroethylene	24	Lognormal (0.48,0.26)
174	OATETR	30	Perchloroethylene	24	Lognormal (0.45,0.23)
175	SFTETR97	30	Perchloroethylene	24	Lognormal (0.75,1.10)
176	SFTETR98	30	Perchloroethylene	24	Lognormal (0.65,0.93)
177	SFTETR99	30	Perchloroethylene	24	Lognormal (0.43,0.18)
178	SFTETR	30	Perchloroethylene	24	Lognormal (0.67,0.91)
179	SCTETR97	30	Perchloroethylene	24	Lognormal (1.66,1.75)
180	SCTETR98	30	Perchloroethylene	24	Lognormal (1.33,1.61)
181	SCTETR99	30	Perchloroethylene	24	Lognormal (1.49,1.59)
182	SCTETR	30	Perchloroethylene	24	Lognormal (1.49,1.68)
183	CATRIC97	30	Trichloroethylene	24	Lognormal (0.30,0.15)
184	CATRIC98	30	Trichloroethylene	24	Lognormal (0.27,0.09)
185	CATRIC99	30	Trichloroethylene	24	Lognormal (0.33,0.16)

(continued)

Outdoors					
Case Number	Case Name	Ref	Pollutant	Averaging Period	Distribution Type (Data)
186	CATRIC[a]	30	Trichloroethylene	24	Lognormal (0.30,0.13)
187	OATRIC97	30	Trichloroethylene	24	Lognormal (0.28,0.04)
188	OATRIC98	30	Trichloroethylene	24	Lognormal (0.28,0.04)
189	OATRIC99	30	Trichloroethylene	24	Lognormal (0.27,0.03)
190	OATRIC	30	Trichloroethylene	24	Lognormal (0.28,0.04)
191	SFTRIC97	30	Trichloroethylene	24	Lognormal (0.29,0.17)
192	SFTRIC98	30	Trichloroethylene	24	Lognormal (0.24,0.06)
193	SFTRIC99	30	Trichloroethylene	24	Lognormal (0.27,0.00)
194	SFTRIC	30	Trichloroethylene	24	Lognormal (0.27,0.11)
195	SCTRIC97	30	Trichloroethylene	24	Lognormal (0.40,0.24)
196	SCTRIC98	30	Trichloroethylene	24	Lognormal (0.36,0.19)
197	SCTRIC99	30	Trichloroethylene	24	Lognormal (0.45,0.39)
198	SCTRIC	30	Trichloroethylene	24	Lognormal (0.40,0.27)

[a] Indicates case marked as default. See Table B-7a for recommended weights for default cases.

[b] Data for these cases are based on week-long measurements. Although they are included among model inputs for the 24-hour averaging period, they are best treated as "practice" data sets.

[c] Data for these cases are based on 48-hour measurements. Although they are included among model inputs for the 24-hour averaging period, they are best treated as "practice" data sets.

Table B-7a Recommended Weights (in Percents) for Default Cases for Outdoors

	24-Hour		Day Time		Night Time	
	Case Name (#)	Weight	Case Name (#)	Weight	Case Name (#)	Weight
Benzene	CABENZ (106)	100				
Benzo(a)pyrene	CABAP (122)	100	PTMDYL (16)	100	PTMNTL (17)	100
Carbon Monoxide	CRIAQALL (76)	100				
Chloroform	CACHL (138)	100				
Formaldehyde	CAFORM (154)	100				
Nitrogen Dioxide	HARVLAL (36)	100				
PM10	PTEAMFL (44)	100	PTEAMFL (45)	100	PTEAMFL (46)	100
Perchloroethylene (Tetrachloroethylene)	CATETR (170)	100				
Trichloroethylene	CATRIC (186)	100				

Level 3 Inputs

Pollutant-specific inputs available for Level 3 of the model are summarized in Table B-8. All inputs are specific to the residential environment. Indoor sources, penetration factors and indoor sinks are available for three pollutants—benzo(a)pyrene, chloroform and nitrogen dioxide. Outdoor concentration distributions (based on daily averages) are available for all pollutants in the model except total PAHs. As noted in a footnote to the table, inputs are also available for volumes and air exchange rates, but these are not pollutant-specific.

Of the six categories of indoor sources (see Section 4.1), model inputs are currently available for two types--long-term (no loading) sources (Table B-9) and frequent (no loading) sources (Table B-10). Each of the two tables lists all inputs for each case name associated with each pollutant.. Distributional data on volumes, air exchange rates, penetration factors, indoor reactive decay and indoor adsorption are summarized in Tables B-11 through B-15, respectively. Outdoor concentrations for level 3 (24 hour average only) are re summarized in Table B-16.

Table B-8 Summary of Pollutant-specific Inputs* Available for Model Level 3

Pollutant	Long-Term (No Loading) Sources	Frequent (No Loading) Sources	Outdoor Concs (Daily)	Penetration Factors	Indoor Sinks		
					RD[a] (k_1)	AD[b] (k_2)	Dep[c] (k_3)
Benzene			x				
Benzo(a)pyrene	x		x	x	x		
Carbon Monoxide			x				
Chloroform		x	x	x	x		
Formaldehyde			x				
Nitrogen Dioxide	x	x	x	x	x		
PM10			x				
Perchloroethylene			x				x
Trichloroethylene			x				
Total PAHs			x				

*Inputs for volumes and air exchange rates are also available, but these are not pollutant-specific

[a] k_1 = Reactive Decay

[b] k_2 = Net Surface Adsorption Rate = adsorption – de-adsorption

[c] k_3 = Net Deposition Rate = deposition - resuspension

Table B-9 Inputs for Long Term (No Loading) Indoor Sources (Level 3)

Pollutant	Case Name	Ref	Input Parameter	Distribution/Value(s)
Benzo(a)pyrene	SOURCE1	4	Percent of Cases	28
		4	Quantity Present	Normal (1, 0)
		A1b	When Installed	Normal (12, 0)
		4	Initial Emission Rate	Lognormal (390, 390)
		A2c	Decline in Rate	Normal (0, 0)
	SOURCE2a	4	Initial Emission Rate	Lognormal (390, 1285)
	SOURCE3a	4	Initial Emission Rate	Percentile (0, 5; 50, 10; 75, 20; 80, 66; 85, 218; 90, 721; 95, 2383; 100, 8800)
Nitrogen Dioxide	PILOT	7	Percent of Cases	68.1 (Linked to COOKING)
		14	Quantity Present	Percentile (0, 128.8; 25, 257.5; 50, 343.3; 75, 429.2; 100, 643.8)
				Normal (12, 0)
		A1b	When Installed	Normal (9.15, 2.3)
		15	Initial Emission Rate	Normal (0, 0)
		A2c	Decline in Rate	

[a] Other inputs same as for SOURCE1.

[b] Arbitrary values; for a constant emission rate, as assumed in this case, the model does not use this input parameter.

[c] The appropriate value is zero when a constant emission rate is assumed within each modeled structure.

Table B-10 Inputs for Frequent (No Loading) Indoor Sources (Level 3)

Pollutant	Case Name	Ref	Input Parameter	Distribution/Value(s)
Chloroform	ALL	A1a	Percent of Cases	100
		16	Quantity Present	Lognormal (99.2, 24.8)
		A2b	Episodes per Day	Lognormal (10, 5)
		A1a	Start Timec	(1, 1, 1, 1, 1, 2, 4, 6, 8, 6, 4, 4, 6, 4, 4, 4, 6, 8, 8, 8, 6, 4, 2, 1) Normal (1, 0)
		A2b	Duration	Yes
		A1a	Overlapping Episodes	Lognormal (5.2, 3.0)
		2	Initial Emission Rate	Normal (0, 0)
		A3d	Decline in Rate	
	ALL2e	2	Initial Emission Rate	Lognormal (8.5, 2.6)
Nitrogen Dioxide	COOKING	7	Percent of Cases	73.3
		14	Quantity Present	Lognormal (150, 50)
		14	Episodes per Day	Frequency (15%-0; 50%-1, 20%-2; 15%-3)
		A1a	Start Timec	(0, 0, 0, 0, 0, 0, 0, 26, 0, 0, 0, 0, 22, 0, 0, 0, 0, 0, 52, 0, 0, 0, 0, 0) Lognormal (33.3, 33.3)
		17	Duration	No
		A1a	Overlapping Episodes	Normal (9.15, 2.3)
		15	Initial Emission Rate	Normal (0, 0)
		A3d	Decline in Rate	
	RANGEHT	17	Percent of Cases	2.8 (Linked to COOKING)
		A1a	Quantity Present	Normal (300, 0)
		17	Episodes per Day	Frequency (66%-0; 34%-1)
		A1a	Start Timec	(0, 0, 0, 0, 0, 25, 25, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 25, 25, 0, 0, 0)
		17	Duration	Lognormal (144, 72)
		A1a	Overlapping Episodes	No
		15	Initial Emission Rate	Normal (9.15, 2.3)
		A3d	Decline in Rate	Normal (0, 0)

[a]*Assumed value based on professional judgment.*

[b] *Values were chosen such that the product of episodes per day times quantity present times duration of use was consistent with the average quantity used per day, as determined from reference 16.*

[c] *Percent share for each of 24 hourly periods, starting with midnight to 1:00 a.m.*

[d] *The appropriate value is zero when a constant emission rate is assumed within each modeled structure.*

[e] *Other inputs same as for ALL.*

Table B-11 Inputs for Volumes (Level 3)

Case Name	Ref	Distribution/Value(s)
RTI-TMLA	2, 20	Lognormal (274.9, 110.6)
SOCAL-3	8, 20	Lognormal (309.5, 159.8)
ADM	21	Lognormal (354, 101)

Table B-12 Inputs for Air Exchange Rates (Level 3)

Case Name	Ref	Distribution/Value(s)
TEAMLA1	2, 20	Lognormal (0.94, 0.82)
TEAMLA2	2, 20	Lognormal (2.83, 2.54)
SOCAL1	8	Lognormal (0.78, 0.63)
SOCAL2	8	Lognormal (1.51, 1.47)
SOCAL3	8	Lognormal (0.58, 0.47)
CALIAQSC	10	Lognormal (0.77, 0.57)
ADM	21	Lognormal (0.70, 0.52)
PTEAM	4	Lognormal (1.25, 1.02)
LIGO1 (public access buildings)	34	Lognormal(1.15, 1.03)
WILS1	35	Lognormal (0.47,0.34)
WILS2	35	Lognormal (0.79,0.57)
WILS3	35	Lognormal (0.54,0.34)

Table B-13 Inputs for Penetration Factors (Level 3)

Pollutant	Case Name	Ref	Distribution/Value(s)
Benzo(a)pyrene	PEN1	4	Normal (0.6, 0)
Chloroform	PEN1	A1a	Normal (1, 0)
Nitrogen Dioxide	PEN1	18	Normal (1, 0)
Benzene	LEW1	31	Normal (1, 0)

[a] *Assumed value based on professional judgment.*

Table B-14 Inputs for Indoor Sinks – Reactive Decay (Level 3)

Pollutant	Case Name	Ref	Distribution/Value(s)
Benzo(a)pyrene	SINK1	4	Normal (0, 0)
Chloroform	SINK1	A1a	Normal (0, 0)
Nitrogen Dioxide	SINK1	15	Lognormal (0.5, 0.3)
Nitrogen Dioxide	SINK2	18, 19	Lognormal (0.8, 0.3)
Nitrogen Dioxide	SPIC1	32	Lognormal (1,18, 0.16)

[a] *Assumed value based on professional judgment.*

Table B-15 Inputs for Indoor Sinks – Adsorption (Level 3)

Pollutant	Case Name	Ref	Distribution/Value(s)
Perchloroethylene	COLO1 (empty chamber)	33	Normal (0.15, 0)
Perchloroethylene	COLO2 (carpet)	33	Normal (0.17, 0)
Perchloroethylene	COLO3 (blown vinyl)	33	Normal (0.17, 0)
Perchloroethylene	COLO4 (gypsum board)	33	Normal (0.06, 0)

Table B-16 Concentration Distributions for Outdoors (Level 3)

			Outdoors		
Case Number	Case Name	Ref	Pollutant	Averaging Period	Distribution Type (Data)
3	TXNETALL	13	Benzene	24	Lognormal (8.04,6.78)
4	TXNETSCL	13	Benzene	24	Lognormal (10.20,7.07)
5	TXNETSFL	13	Benzene	24	Lognormal (7.27,6.48)
6	TXNETRSL	13	Benzene	24	Lognormal (7.46,5.83)
7	WOODOUTL	1	Benzene	24	Lognormal (1.20,0.62)
8	TM87B24L	2	Benzene	24	Lognormal (5.10,3.46)
9	TM87W24L	2	Benzene	24	Lognormal (6.41,3.83)
10	TM87S24L	2	Benzene	24	Lognormal (3.75,2.41)
11	PTM24L	4	Benzo(a)Pyrene	24	Lognormal (0.30,0.36)
12	TXNETALL	13	Chloroform	24	Lognormal (0.19,0.59)
13	TXNETSCL	13	Chloroform	24	Lognormal (0.18,0.16)
14	TXNETSFL	13	Chloroform	24	Lognormal (0.17, 0.14)
15	TXNETRSL	13	Chloroform	24	Lognormal (0.21,0.86)
16	TM87B24L	2	Chloroform	24	Lognormal (0.64,1.11)
17	TM87W24L	2	Chloroform	24	Lognormal (0.49,0.80)
18	TM87S24L	2	Chloroform	24	Lognormal (0.79,1.36)
19	TXNETALL	13	Benzo(a)Pyrene	24	Lognormal (0.84,1.87)
20	TXNETSCL	13	Benzo(a)Pyrene	24	Lognormal (0.42,0.74)
21	TXNETSFL	13	Benzo(a)Pyrene	24	Lognormal (0.54,0.88)
22	TXNETRSL	13	Benzo(a)Pyrene	24	Lognormal (1.03,2.02)
23	TOXALL	13	Formaldehyde	24	Lognormal (4.00,3.20)
24	TOXSCL	13	Formaldehyde	24	Lognormal (4.60,3.70)
25	TOXSFL	13	Formaldehyde	24	Lognormal (3.20,2.40)
26	TOXRSL	13	Formaldehyde	24	Lognormal (3.60,2.70)
27	HARVLAL[a,c]	7	Nitrogen Dioxide	24	Lognormal (72.00,39.30)
28	SOCLJANL[b]	8	Nitrogen Dioxide	24	Lognormal (107.00,42.50)
29	SOCLMARL[b]	8	Nitrogen Dioxide	24	Lognormal (53.70,22.60)
30	SOCLJULL[b]	8	Nitrogen Dioxide	24	Lognormal (77.20,34.20)
31	TXNETALL	13	Inhalable Particles (PM10)	24	Lognormal (38.60,34.60)
32	TXNETSCL	13	Inhalable Particles (PM10)	24	Lognormal (51.60,37.20)
33	TXNETSFL	13	Inhalable Particles (PM10)	24	Lognormal (30.70,24.80)
34	TXNETRSL	13	Inhalable Particles (PM10)	24	Lognormal (37.00,34.90)
35	PTEAMFL[a]	4	Inhalable Particles (PM10)	24	Lognormal (91.20,50.70)
36	TXNETALL	13	Perchloroethylene	24	Lognormal (2.18,3.89)
37	TXNETSCL	13	Perchloroethylene	24	Lognormal (3.78,7.08)
38	TXNETSFL	13	Perchloroethylene	24	Lognormal (2.14,2.14)
39	TXNETRSL	13	Perchloroethylene	24	Lognormal (1.40,1.65)
40	WOODOUTL	1	Perchloroethylene	24	Lognormal (0.53,1.99)

(continued)

			Outdoors		
Case Number	Case Name	Ref	Pollutant	Averaging Period	Distribution Type (Data)
41	TM87B24L	2	Perchloroethylene	24	Lognormal (2.90,2.55)
42	TM87W24L	2	Perchloroethylene	24	Lognormal (4.06,3.08)
43	TM87S24L	2	Perchloroethylene	24	Lognormal (1.75,0.99)
44	TXNETALL	13	Trichloroethylene	24	Lognormal (0.87,2.02)
45	TXNETSCL	13	Trichloroethylene	24	Lognormal (0.96,1.07)
46	TXNETSFL	13	Trichloroethylene	24	Lognormal (1.01,3.08)
47	TXNETRSL	13	Trichloroethylene	24	Lognormal (0.70,1.39)
48	TM87B24L	2	Trichloroethylene	24	Lognormal (0.16,0.14)
49	TM87W24L	2	Trichloroethylene	24	Lognormal (0.21,0.18)
50	TM87S24L	2	Trichloroethylene	24	Lognormal (0.11,0.05)
51	CRIAQALL[c]	10	Benzene	24	Lognormal (8.63,7.99)
52	CRIAQPGL[c]	10	Benzene	24	Lognormal (5.43,3.20)
53	CRIAQSCL[c]	10	Benzene	24	Lognormal (15.02,11.18)
54	CRIAQSDL[c]	10	Benzene	24	Lognormal (6.07,2.56)
55	CRIAQALL[c]	10	Nitrogen Dioxide	24	Lognormal (43.30,32.00)
56	CRIAQPGL[c]	10	Nitrogen Dioxide	24	Lognormal (33.90,24.50)
57	CRIAQSCL[c]	10	Nitrogen Dioxide	24	Lognormal (65.80,41.40)
58	CRIAQSDL[c]	10	Nitrogen Dioxide	24	Lognormal (39.50,22.60)
59	CRIAQALL[a,c]	10	Carbon Monoxide	24	Lognormal (1.10,1.40)
60	CRIAQPGL[c]	10	Carbon Monoxide	24	Lognormal (0.80,0.60)
61	CRIAQSCL[c]	10	Carbon Monoxide	24	Lognormal (2.20,2.30)
62	CRIAQSDL[c]	10	Carbon Monoxide	24	Lognormal (0.80,0.60)
65	CABENZ97	30	Benzene	24	Lognormal (1.86,2.16)
66	CABENZ98	30	Benzene	24	Lognormal (1.87,1.97)
67	CABENZ99	30	Benzene	24	Lognormal (1.68,2.07)
68	CABENZ[a]	30	Benzene	24	Lognormal (1.82,2.08)
69	OABENZ97	30	Benzene	24	Lognormal (1.19,1.34)
70	OABENZ98	30	Benzene	24	Lognormal (1.17,1.08)
71	OABENZ99	30	Benzene	24	Lognormal (1.22,1.38)
72	OABENZ	30	Benzene	24	Lognormal (1.20,1.27)
73	SFBENZ97	30	Benzene	24	Lognormal (1.76,174)
74	SFBENZ98	30	Benzene	24	Lognormal (1.87,1.75)
75	SFBENZ99	30	Benzene	24	Lognormal (2.04,2.37)
76	SFBENZ	30	Benzene	24	Lognormal (1.84,1.82)
77	SCBENZ97	30	Benzene	24	Lognormal (2.63,2.13)
78	SCBENZ98	30	Benzene	24	Lognormal (2.62,2.46)
79	SCBENZ99	30	Benzene	24	Lognormal (2.43,2.69)
80	SCBENZ	30	Benzene	24	Lognormal (2.59,2.43)

(continued)

	Outdoors				
Case Number	Case Name	Ref	Pollutant	Averaging Period	Distribution Type (Data)
81	CABAP97	30	Benzo(a)pyrene	24	Lognormal (0.15,0.30)
82	CABAP98	30	Benzo(a)pyrene	24	Lognormal (0.18,0.39)
83	CABAP99	30	Benzo(a)pyrene	24	Lognormal (0.14,0.28)
84	CABAP[a]	30	Benzo(a)pyrene	24	Lognormal (0.16,0.32)
85	OABAP97	30	Benzo(a)pyrene	24	Lognormal (0.18,0.45)
86	OABAP98	30	Benzo(a)pyrene	24	Lognormal (0.24,0.65)
87	OABAP99	30	Benzo(a)pyrene	24	Lognormal (0.17,0.42)
88	OABAP	30	Benzo(a)pyrene	24	Lognormal (0.20,0.50)
89	SFBAP97	30	Benzo(a)pyrene	24	Lognormal (0.10,0.16)
90	SFBAP98	30	Benzo(a)pyrene	24	Lognormal (0.16,0.30)
91	SFBAP99	30	Benzo(a)pyrene	24	Lognormal (0.12,0.20)
92	SFBAP	30	Benzo(a)pyrene	24	Lognormal (0.12,0.22)
93	SCBAP97	30	Benzo(a)pyrene	24	Lognormal (0.15,0.27)
94	SCBAP98	30	Benzo(a)pyrene	24	Lognormal (0.14,0.24)
95	SCBAP99	30	Benzo(a)pyrene	24	Lognormal (0.14,0.23)
96	SCBAP	30	Benzo(a)pyrene	24	Lognormal (0.14,0.25)
97	CACHL97	30	Chloroform	24	Lognormal (0.19,0.21)
98	CACHL98	30	Chloroform	24	Lognormal (0.15,0.15)
99	CACHL99	30	Chloroform	24	Lognormal (0.25,0.04)
100	CACHL[a]	30	Chloroform	24	Lognormal (0.20,0.19)
101	OACHL97	30	Chloroform	24	Lognormal (0.29,0.14)
102	OACHL98	30	Chloroform	24	Lognormal (0.25,0.03)
103	OACHL99	30	Chloroform	24	Lognormal (0.25,0.03)
104	OACHL	30	Chloroform	24	Lognormal (0.27,0.09)
105	SFCHL97	30	Chloroform	24	Lognormal (0.09,0.08)
106	SFCHL98	30	Chloroform	24	Lognormal (0.07,0.04)
107	SFCHL99	30	Chloroform	24	Lognormal (0.25,0.03)
108	SFCHL	30	Chloroform	24	Lognormal (0.09,0.08)
109	SCCHL97	30	Chloroform	24	Lognormal (0.25,0.02)
110	SCCHL98	30	Chloroform	24	Lognormal (0.25,0.04)
111	SCCHL99	30	Chloroform	24	Lognormal (0.26,0.06)
112	SCCHL	30	Chloroform	24	Lognormal (0.25,0.04)
113	CAFORM97	30	Formaldehyde	24	Lognormal (4.85,4.31)
114	CAFORM98	30	Formaldehyde	24	Lognormal (5.22,4.83)
115	CAFORM99	30	Formaldehyde	24	Lognormal (5.29,4.60)
116	CAFORM[a]	30	Formaldehyde	24	Lognormal (5.13,4.60)
117	OAFORM97	30	Formaldehyde	24	Lognormal (5.03,5.16)

(continued)

			Outdoors		
Case Number	Case Name	Ref	Pollutant	Averaging Period	Distribution Type (Data)
118	OAFORM98	30	Formaldehyde	24	Lognormal (5.00,4.66)
119	OAFORM99	30	Formaldehyde	24	Lognormal (4.19,3.32)
120	OAFORM	30	Formaldehyde	24	Lognormal (4.74,4.36)
121	SFFORM97	30	Formaldehyde	24	Lognormal (2.34,1.44)
122	SFFORM98	30	Formaldehyde	24	Lognormal (2.30,1.81)
123	SFFORM99	30	Formaldehyde	24	Lognormal (2.61,2.07)
124	SFFORM	30	Formaldehyde	24	Lognormal (2.40,1.76)
125	SCFORM97	30	Formaldehyde	24	Lognormal (5.38,3.54)
126	SCFORM98	30	Formaldehyde	24	Normal (5.80,3.27)
127	SCFORM99	30	Formaldehyde	24	Lognormal (6.59,4.89)
128	SCFORM	30	Formaldehyde	24	Lognormal (6.06,4.41)
129	CATETR97	30	Perchloroethylene	24	Lognormal (0.78,0.96)
130	CATETR98	30	Perchloroethylene	24	Lognormal (0.70,0.86)
131	CATETR99	30	Perchloroethylene	24	Lognormal (0.76,0.68)
132	CATETR[a]	30	Perchloroethylene	24	Lognormal (0.74,0.88)
133	OATETR97	30	Perchloroethylene	24	Lognormal (0.46,0.24)
134	OATETR98	30	Perchloroethylene	24	Lognormal (0.42,0.18)
135	OATETR99	30	Perchloroethylene	24	Lognormal (0.48,0.26)
136	OATETR	30	Perchloroethylene	24	Lognormal (0.45,0.23)
137	SFTETR97	30	Perchloroethylene	24	Lognormal (0.75,1.10)
138	SFTETR98	30	Perchloroethylene	24	Lognormal (0.65,0.93)
139	SFTETR99	30	Perchloroethylene	24	Lognormal (0.43,0.18)
140	SFTETR	30	Perchloroethylene	24	Lognormal (0.67,0.91)
141	SCTETR97	30	Perchloroethylene	24	Lognormal (1.66,1.75)
142	SCTETR98	30	Perchloroethylene	24	Lognormal (1.33,1.61)
143	SCTETR99	30	Perchloroethylene	24	Lognormal (1.49,1.59)
144	SCTETR	30	Perchloroethylene	24	Lognormal (1.49,1.68)
145	CATRIC97	30	Trichloroethylene	24	Lognormal (0.30,0.15)
146	CATRIC98	30	Trichloroethylene	24	Lognormal (0.27,0.09)
147	CATRIC99	30	Trichloroethylene	24	Lognormal (0.33,0.16)
148	CATRIC[a]	30	Trichloroethylene	24	Lognormal (0.30,0.13)
149	OATRIC97	30	Trichloroethylene	24	Lognormal (0.28,0.04)
150	OATRIC98	30	Trichloroethylene	24	Lognormal (0.28,0.04)
151	OATRIC99	30	Trichloroethylene	24	Lognormal (0.27,0.03)
152	OATRIC	30	Trichloroethylene	24	Lognormal (0.28,0.04)
153	SFTRIC97	30	Trichloroethylene	24	Lognormal (0.29,0.17)
154	SFTRIC98	30	Trichloroethylene	24	Lognormal (0.24,0.06)

(continued)

Outdoors					
Case Number	Case Name	Ref	Pollutant	Averaging Period	Distribution Type (Data)
155	SFTRIC99	30	Trichloroethylene	24	Lognormal (0.27,0.00)
156	SFTRIC	30	Trichloroethylene	24	Lognormal (0.27,0.11)
157	SCTRIC97	30	Trichloroethylene	24	Lognormal (0.40,0.24)
158	SCTRIC98	30	Trichloroethylene	24	Lognormal (0.36,0.19)
159	SCTRIC99	30	Trichloroethylene	24	Lognormal (0.45,0.39)
160	SCTRIC	30	Trichloroethylene	24	Lognormal (0.40,0.27)

[a] Indicates case marked as default. See Table B-16a for recommended weights for default cases.

[b] Data for these cases are based on week-long measurements. Although they are included among model inputs for the 24-hour averaging period, they are best treated as "practice" data sets.

[c] Data for these cases are based on 48-hour measurements. Although they are included among model inputs for the 24-hour averaging period, they are best treated as "practice" data sets.

Table B-16a. Recommended Weights (in Percents) for Default Cases for Outdoors (Level3)

	24-Hour	
	Case Name (#)	Weight
Benzene	CABENZ (68)	100
Benzo(a)pyrene	CABAP (84)	100
Carbon Monoxide	CRIAQALL (59)	100
Chloroform	CACHL (100)	100
Formaldehyde	CAFORM (116)	100
Nitrogen Dioxide	HARVLAL (27)	100
PM10	PTEAMFL (35)	100
Perchloroethylene (Tetrachloroethylene)	CATETR (132)	100
Trichloroethylene	CATRIC (148)	100

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Appendix C:
Calculations for Development of Input Data Sets

GEOMET Technologies, Inc.

20251 Century Boulevard • Germantown, MD 20874 • Telephone (301) 428-9898 • Telefax (301) 428-9482

MEMORANDUM   IE-4405

TO: Susan Lum

FROM: Michael Koontz

DATE: October 23, 1995

SUBJECT: Calculations for Development of Input Data Sets

As you know, it was necessary for GEOMET to undertake a variety of data processing and calculation steps to develop some of the input data sets for the CPIEM software. The purpose of this memorandum is to document these steps, which are summarized below as they relate to indoor/outdoor concentrations, air exchange rates, volumes, and indoor sources.

Residential Indoor Concentrations

• For the 1984 TEAM study, the 1990 Woodland study, and the 1990 PTEAM study, the investigators reported the average concentration and the standard error for monitored VOCs (TEAM and Woodland) and PAHs (PTEAM). Because the model inputs require a mean and standard deviation, the standard deviation was obtained by multiplying the reported standard error by the square root of the reported sample size.

• For the 1987 TEAM study, 12-hour daytime and nighttime VOC samples were collected. The means and standard errors were reported for these data sets, but not for the 24-hour data. Consequently, files containing sampling results for each participating household were obtained through the EPA Environmental Monitoring Systems Laboratory in Las Vegas, and the daytime/nighttime values for each household were averaged to develop a 24-hour average from which the mean and standard deviation were computed. For consistency, the means and standard deviations for the 12-hour samples were also computed from this set of data.

• For the 1984-85 study of formaldehyde concentrations in conventional and mobile homes, conducted by the California Department of Health Services, the means and standard deviations were reported in a journal article along with histograms. Information was extracted from the histograms to summarize percentiles of the cumulative frequency

distribution for conventional homes during the winter and for mobile homes during the both the summer and the winter.

Concentrations for Travel in Vehicle

* Results were reported by the South Coast Air Quality Management District for a number of commuting trips during 1987-88 that averaged 33 minutes in duration. The results were reported on a volume/volume (parts per billion) basis. Because the model requires mass/volume (e.g., mg/m^3 or $\mu g/m^3$), the published results were converted using a formula based on the molecular weight of each compound.

Outdoor Concentrations

* For the 1984 TEAM study, the 1987 TEAM study, the 1990 Woodland study and the 1990 PTEAM study, the same processing and analysis steps were applied as described above for indoor concentrations.

* Data from the ARB air toxics monitoring network were acquired from ARB and processed and analyzed to developed distributional information (means and standard deviations) for selected VOCs (benzene, chloroform, formaldehyde, perchloroethylene, and trichloroethylene) and for benzo[a]pyrene. After eliminating sites with limited data, the records for each pollutant were statistically summarized across all monitoring sites. This procedure was followed for the state as a whole and for three regions (South Coast, San Francisco Bay area, and remainder of the state). A similar procedure was followed for inhalable particles (PM10) using a separate file obtained from ARB. The VOC results, reported in volume/volume units, were converted to mass/volume units using a formula based on the molecular weight of each compound.

Residential Air Exchange Rates

* For the 1987 TEAM study, air exchange rates measured during February and July were processed and summarized separately, using a database of PFT measurements developed by Versar and GEOMET for the U.S. Environmental Protection Agency. Air exchange rates for the 1984-85 study for SoCal Gas were also available in this database, but some errors were found in the portion of the database pertaining to this study; consequently, summaries reported by the investigators were used instead.

* For 1990 studies by ADM Associates and Berkeley Solar Group, the air exchange rates were not summarized by the investigators but the individual results were listed in their respective reports. The data listed in the reports were entered in a spreadsheet and then summarized statistically.

Residential Volumes

* For the 1987 TEAM study, house volumes were summarized statistically using a database of PFT measurements developed by Versar and GEOMET for the U.S. Environmental Protection Agency. Volumes for the 1984-85 study for SoCal Gas were also in this database. The SoCal study had three measurement periods (March 1984, July 1984, and January 1985) for largely the same set of houses. Because the 1984 data were found to have some errors, the summary statistics on house volumes were calculated using the 1985 data.

- For the 1990 study by ADM Associates, house volumes were not summarized by the investigators but were listed in their report. The listed data were entered in a spreadsheet and the summarized statistically.

Residential Indoor Sources

- Inputs for chloroform on indoor water uses were developed from a report by the Metropolitan Water District of Southern California, which summarized daily uses per household for toilets, faucets, baths/showers, dishwashers and clothes washers. From these individual sources, total household water use per day was computed and used in developing model inputs reflecting all water uses combined.

- Inputs for benzo[a]pyrene were largely taken from the report on the 1990 PTEAM study. The investigators reported the average source strength but not the standard deviation. The standard deviation was estimated using limited statistics on percentiles reported by the investigators coupled with assumptions for the percentiles that were not reported.

- Inputs for nitrogen dioxide were based on unpublished data from the gas industry, obtained from the Gas Research Institute, on daily and hourly gas consumption by gas ranges, including pilot light consumption. The data were analyzed to separate the pilot light consumption from the remainder of range consumption (i.e., for cooking or for supplemental heating). Fuel consumption summary statistics initially were developed separately for breakfast, lunch and dinner. The fuel-consumption inputs were also used to develop inputs for duration of cooking for each meal. Subsequently, the three meals were combined to develop a single source for cooking; a Monte Carlo simulation was performed to develop an estimate of the standard deviation for duration of cooking for this combined source.

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Appendix D:
UNC User's Guide, Verification, and Validation

Introduction

UNC is a program developed for use with CPIEM to allow the user to conduct an uncertainty analysis for given CPIEM factors. For each CPIEM factor, the model inputs specify the distribution of that factor. Uncertainty analyses can be applied to CPIEM factors used for level 1-2, or for level 3, or both. The UNC program is in two parts. The first part of the program allows the user to define uncertainty distributions for their selected CPIEM inputs. UNC will randomly generate sets of CPIEM inputs for each factor by selecting values from the uncertainty distributions. The second part of the program reads in the output variability distributions from CPIEM and generates summary tables and graphs of the uncertainty of the variability distribution.

Installing and Uninstalling UNC

To install UNC, run the UNC_setup.exe installation program. The default installation folder is "c:\Program Files\CPIEMunc" The folder "c:\Program Files\CPIEMunc\sampdata" contains example input files. To uninstall UNC, run the uninstall program uninstal.exe found in the installation folder. When prompted, you can delete the additional data files in the installation folder that were created by UNC since the installation. Be sure to reboot your computer before reinstalling UNC.

The user can change from the default installation folder to another folder during installation. Afterwards, the user can change the file locations using the Defaults submenu of the Options menu. As discussed below, choosing this option brings up a screen where the user can tell the program what to use for the default locations for the initial directory, where the program expects to find data files, and the execution directory, where the program expects to find the executable files. The user can change the currently defined locations by left clicking on the box at the end of the directory location. This will bring up a new screen where the user can choose a particular drive and subdirectories as well as map onto a new network drive by left clicking on the box labeled NETWORK. Once the desired location has been selected the user must press the box labeled OK to return to the previous window. The user, however, should NOT change the default location of the executable files, unless ALL of the program files are moved.

Files

The three sampdata example input files example1.udt, example2.udt, and example3.udt show typical input formats for the four uncertainty types described below (continuous, discrete, default, case name). These examples are not intended to be realistic, but are instead provided to show how correctedly formatted inputs should appear. To examine and execute these examples, select an example file (Input Uncertainty Data menu, Select submenu), then select Modify from the Input Uncertainty Data menu and select the Define Factors button.

Using the UNC module to input uncertainty data will create a file with extension udt, e.g., test.udt. The user chooses the directory/folder using the Save As menu. When the test.udt file is executed (Execute menu), the program creates intermediate ASCII files test.int and test.dat and the output file test.out containing the uncertainty inputs for CPIEM (in the same folder as the test.udt file). Using the Calculate/View Statistics menu, the user gives the folder and name of a

concatenated CPIEM output statistics file with extension sta, e.g., all.sta. The program creates, in the same folder, a summary statistics file with extension ust (e.g., all.ust) and up to two gnuplot graph files with extensions plt (daily) and plth (hourly).

Generate CPIEM Inputs

For each CPIEM factor entered into the data set, the user may specify one of four options (continuous, case name, default, or discrete) for the uncertainty distribution of the parameters for the model input distributions (arithmetic lognormal (Ar. LN), exponential, geometric lognormal (Geo. LN), normal, or triangular). In this document and in the UNC software, the non-standard term "arithmetic lognormal" distribution defines a lognormal distribution where the given parameters are the (arithmetic) mean and standard deviation of the variable. The non-standard term "geometric lognormal" distribution defines a lognormal distribution where the given parameters are the geometric mean and geometric standard deviation of the variable. (By definition, the natural logarithms of the geometric mean and geometric standard deviation equal the mean and standard deviation of the natural logarithm of the variable.) The user then enters specific information for each of the uncertainty distributions requested.

The output of UNC is an ASCII file containing a matrix of X rows by N columns, where X is the number of CPIEM factors that the user entered into the input data file and N is the number of CPIEM simulations to be run. The values in the cth column are the randomly generated sets of values for each of the X CPIEM factors to be used in the cth simulation. For each input factor with a continuous, default, or discrete uncertainty distribution, the cell in row r and column c will contain the parameters for the distribution of the rth input factor for use in the cth simulation. For the case name uncertainty distribution, the cell in row r and column c will contain the case name of the distribution type selected for the rth input factor for use in the cth simulation.

For continuous uncertainty distributions, the user may choose between arithmetic lognormal (Ar. LN), geometric lognormal (Geo. LN), normal or uniform distributions for each parameter of the model input distribution. The user must then enter a mean or minimum and a standard deviation or maximum for each of the parameters for the uncertainty distribution. More specifically, the mean and standard deviation are entered for the normal and arithmetic lognormal distributions, the minimum and maximum are entered for the uniform distribution, and the geometric mean and geometric standard deviation are entered for the geometric lognormal distribution. The parameter may be set to be a constant (i.e., have no uncertainty) by selecting the uniform uncertainty distribution and setting the maximum equal to the minimum. A variant of Latin HyperSquare sampling is then used to derive an output data set for use with CPIEM. The Latin HyperSquare sampling used in UNC takes the uncertainty distributions defined by the user and divides each distribution into N slices, where N is the number of simulations set at the Execute stage. The user chooses either the midpoint or random point sampling method. For each distribution and slice, the UNC program then selects either the midpoint of the slice or a random number from the slice. This number is then randomly allocated to a simulation number in the output file.

For discrete uncertainty distributions, the user enters as many sets of parameters as desired with a minimum of two sets required. The data entry screen for the discrete distributions will tell the user which, and how many, numbers should be in each set (i.e., Amean,std;@ or Amin,mode,max;@). The UNC program then randomly allocates the specified parameter sets into N slots where N is the number of simulations set at the Execute stage. If the number of parameter sets is larger than N, the program randomly picks N parameters sets without replacement. If the number of parameter sets is smaller than N and there are P parameter sets,

the program will randomly pick, without replacement, from the parameter sets P times to fill the first P slots. The program then randomly picks again from the P parameter sets to fill the next set of P slots, and so on until all N slots have been filled.

For default uncertainty distributions, the user enters the parameters used to define the original model input distribution and enters a sample size S. The program then samples from the model input distribution S times, and computes new parameters for the model input distribution based on these S samples. The program repeats this process until all N slots, where N is the number of simulations set at the Execute stage, have been filled.

For case name uncertainty distributions, the user enters as many data set names ("case names") as desired, with a minimum of two names required. The UNC program then randomly allocates the specified case names into N slots where N is the number of simulations set at the Execute stage. If the number of case names is larger than N, the program randomly picks N case names without replacement. If the number of case names is smaller than N and there are D case names, the program will randomly pick, without replacement, from the case names D times to fill the first D slots. The program then randomly picks again from the D case names to fill the next set of D slots, and so on until all N slots have been filled. If the case name uncertainty distribution is selected, the user is still required to enter a statistical distribution for the model input (e.g., normal) although that information is ignored by UNC.

The defined uncertainty distributions for the continuous uncertainty type are truncated so that invalid values will not be generated. Invalid results for a continuous uncertainty distribution would be as follows:

- Mean for an exponential model input distribution that is less than or equal to zero.

- Standard deviation for a geometric lognormal model input distribution that is less than or equal to one, or a standard deviation for any other model input distribution that is less than or equal to zero.

- Mean for an arithmetic or geometric lognormal model input distribution that is less than or equal to zero.

A warning message will be printed out at the end of the output file describing the percentage of the uncertainty distribution that was truncated. If the parameters for triangular or uniform variability distributions for which a continuous uncertainty type has been specified are not in the correct order (e.g., minimum < mode < maximum), the program will set all parameter values to the minimum value (e.g., minimum = mode = maximum). The program will count the number of times this was done, and will print a message at the end of the output file to tell the user how many times this occurred.

The program will also check upon entry for valid values for the default and discrete uncertainty distributions. If an invalid value is entered, the user will get an error message at the time of entry stating the problem with the value so that a valid value may be entered.

Once all of the uncertainty distributions have been defined and the uncertainty input data set has been saved, the UNC program is executed and the resulting uncertainty data is output into a semicolon delimited ASCII file. The user may best view the output by importing the file into EXCEL, specifying that the columns are semicolon delimited, and then using EXCEL's Copy, Paste Special, and Transpose options under the Edit menu to reorganize the output. The user

• then inputs this information into CPIEM and runs CPIEM N times, where N is the number of simulations.
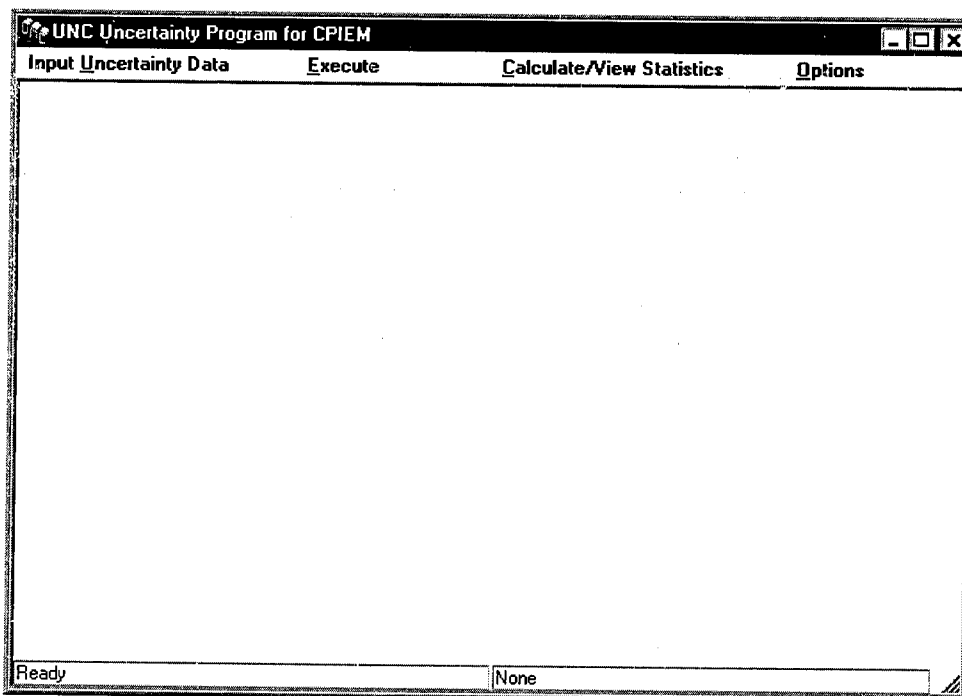
Example UNC uncertainty input files are provided in the folder c:\Program Files\CPIEMunc\sampdata (assuming the default installation folders are used).

Compute Summary Statistics and Graphs

Once CPIEM has been run N times using the uncertainty inputs generated from UNC, the combined output files from CPIEM are read back into UNC so that basic statistics may be calculated and simple plots may be generated summarizing the uncertainty of the level 1-2 or level 3 output variability distributions.

Example UNC statistics input files are provided in the folder c:\Program Files\CPIEMunc\sampdata (assuming the default installation folders are used).

Main Menu

| UNC Uncertainty Program for CPIEM			_ □ ×
Input Uncertainty Data	Execute	Calculate/View Statistics	Options

Ready | None

The Main Menu of UNC appears when the program is loaded. It contains the following pull down menus which can be accessed either by left clicking with the mouse on the desired menu, or by pressing the ALT key and then the key of the underlined letter in the name of the desired menu.

Input Uncertainty Data

Execute

Calculate/View Statistics

Options

Input Uncertainty Data

The Input Uncertainty Data menu allows the user to create new files, select and load existing files, modify a loaded file, save a loaded file, or print a loaded file. The options are as follows and can be accessed either by left clicking with the mouse on the desired option, or by pressing the key of the underlined letter in the name of the desired option.

SeLect   Selects an existing input data set.

New   Creates a new blank input data set.

Modify   Modifies the currently loaded input data set.

Save   Saves the currently loaded input data set.

Save As   Saves the currently loaded input data set under a new name.

Print   Creates a formatted and labeled version of the input data set and opens it using Notepad.
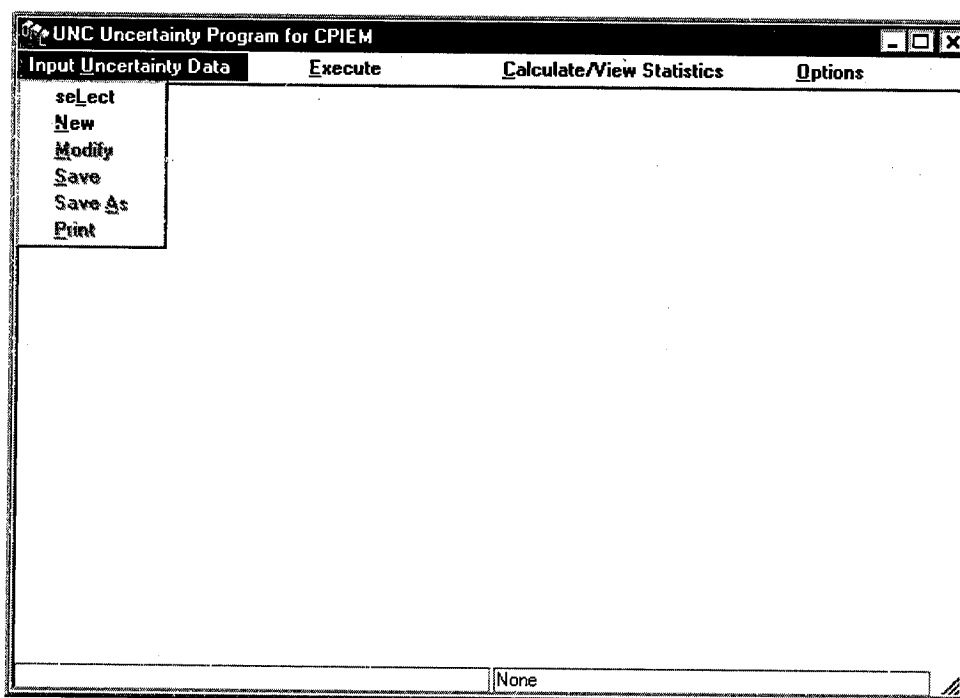
Select. Choosing this option brings up a standard Windows file selection window which lists all available files of the correct type in the current working directory. Files can be deleted, copied, renamed, zipped, etc. from this window.

New. Choosing this option brings up a window to begin creating a new data file. This will be discussed in more detail later.

Print. Choosing this option will create a formatted file, using Notepad, called Input.TXT that can be printed directly from Notepad, or can be saved for later access.

Execute

The Execute Menu contains only one item which can be accessed either by left clicking with the mouse on the option, or by pressing the key of the underlined letter in the name of the option. If the option is grayed, either an input file has not been loaded or a new input file has not been saved.

Create Uncertainty File   Creates an appropriate output uncertainty data set using the currently loaded input file.
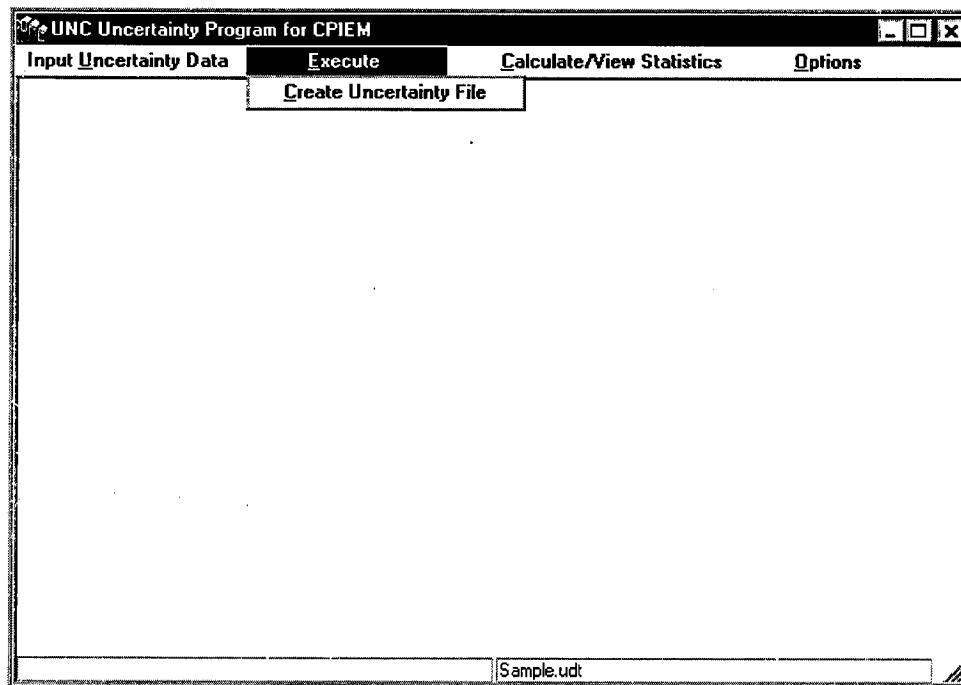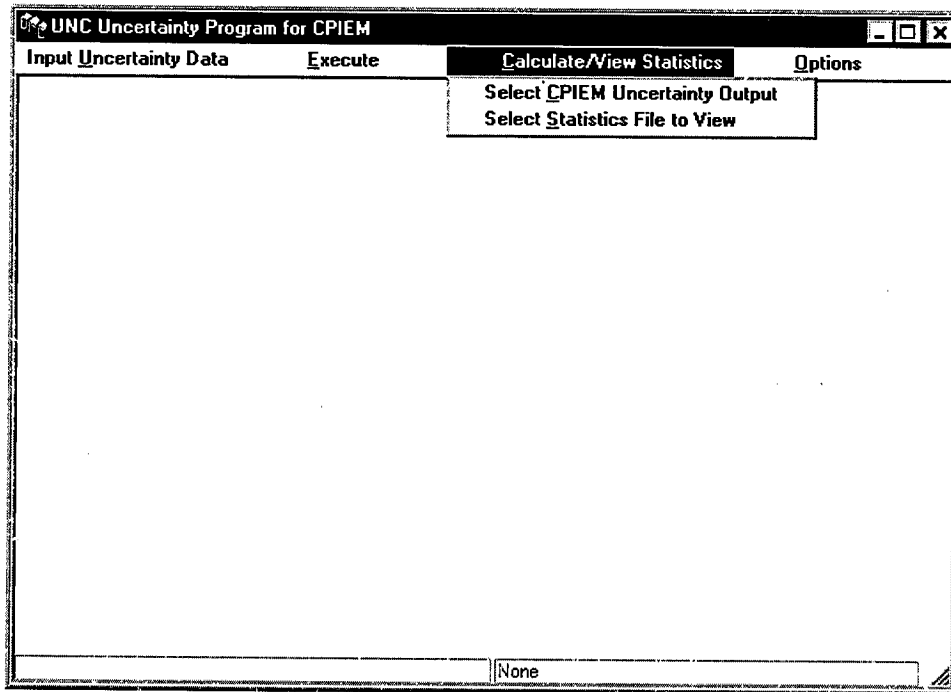

Calculate/View Statistics

The Calculate/View Statistics Menu contains two items which can be accessed either by left clicking with the mouse on the desired option, or by pressing the key of the underlined letter in the name of the desired option.

Select CPIEM Uncertainty Output   Selects an existing CPIEM output file.

Select Statistics File to View   Selects an existing output statistics file.
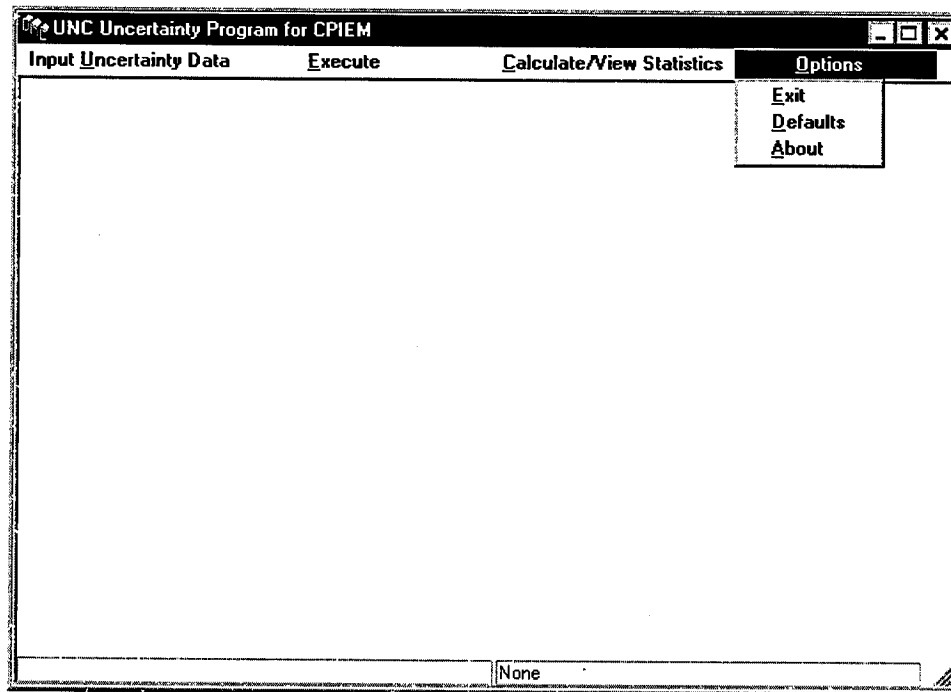
```
┌─────────────────────────────────────────────────────────────────────┐
│ UNC Uncertainty Program for CPIEM                          [_][□][X] │
├─────────────────────────────────────────────────────────────────────┤
│ Input Uncertainty Data      Execute      Calculate/View Statistics      Options │
│                                        ┌──────────────────────────────┐│
│                                        │ Select CPIEM Uncertainty Output ││
│                                        │ Select Statistics File to View  ││
│                                        └──────────────────────────────┘│
│                                                                       │
│                                                                       │
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│                                                                       │
│                                                                       │
│                                        │None                          │
└─────────────────────────────────────────────────────────────────────┘
```

<u>Select CPIEM Uncertainty Output</u>. Choosing this option brings up a standard Windows file selection window which lists all available files of the correct type in the current working directory. Selection of a file causes the generation of the output statistics on the chosen CPIEM output file, brings up a window showing the generated output statistics, and offers the user an option of viewing a graph of the output statistics.

<u>Select Statistics File to View</u>. Choosing this option brings up a standard Windows file selection window which lists all available files of the correct type in the current working directory. Selection of a file opens a window showing the chosen file of output statistics and offers the user an option of viewing a graph of the output statistics.

Options

The Options Menu contains three items which can be accessed either by left clicking with the mouse on the desired option, or by pressing the key of the underlined letter in the name of the desired option.

<u>E</u>xit   Can be used to Exit the UNC program.

<u>D</u>efaults   A pop up window is used to select the working directory for input data files and the working directory for output uncertainty data files.

<u>A</u>bout   Lists the version of the software along with contact information for technical support.

```
┌─────────────────────────────────────────────────────────────────┐
│ ░ UNC Uncertainty Program for CPIEM                    _ □ × │
├─────────────────────────────────────────────────────────────────┤
│ Input Uncertainty Data    Execute    Calculate/View Statistics  │ Options │
│                                              ┌──────────────────┐│
│                                              │ Exit             ││
│                                              │ Defaults         ││
│                                              │ About            ││
│                                              └──────────────────┘│
│                                                                   │
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│                                                                   │
│                                                                   │
│                                                                   │
│                                          │None              │     │
└─────────────────────────────────────────────────────────────────┘
```

Defaults. Choosing this option brings up a screen where the user can tell the program what to use for the default locations for the initial directory, where the program expects to find data files, and the execution directory, where the program expects to find the executable files. The user can change the currently defined locations by left clicking on the box at the end of the directory location. This will bring up a new screen where the user can choose a particular drive and subdirectories as well as map onto a new network drive by left clicking on the box labeled NETWORK. Once the desired location has been selected the user must press the box labeled OK to return to the previous window. The user, however, should NOT change the default location of the executable files, unless ALL of the program files are moved.

Status Bar

The Status Bar is located at the bottom of the Main Window in UNC. The first section lists text that tells the current status of the UNC program. The second section lists the currently loaded input file. If an input file is not loaded, the second section will contain the word None. If an input file has been loaded but has been modified and not yet saved, the name in the second section will appear in brackets.

Navigating within Data Entry Screens

For the data entry screens, the user may use the TAB key to move to the next cell in each row, and may use the ENTER key to move to the next cell in each column if the cell does not have a drop down menu. The user may also navigate between cells by using the arrow keys. Drop down menus may be accessed by either left clicking on the arrow at the end of the box, or by hitting the ENTER key when in a cell with a drop down menu. To select a particular option in a drop down menu, left click on the desired choice, or press the ENTER key and then use the arrow keys until the desired choice is highlighted and then press the ENTER key again. If the

cell does not have a drop down menu, the user must press the ENTER key after entering information, or what was entered will NOT be saved upon moving to the next screen. If the cell background is highlighted, then the data entered in that cell has been saved and will not be lost upon moving to the next screen.

Right clicking on any cell in a screen brings up a menu to allow the user to cut or copy the cell contents and to paste to the selected cell what has been cut or copied from another cell.

Default Filename Extensions

By default, the UNC program expects files of certain types to have certain filename extensions. In some cases, the program will not recognize a file as being of the required type if it does not have the correct extension. For other file types, if the extension is not the default the program will not automatically find it, but it will open it without any problems. The default filename extensions are as follows:

UDT   Input data filename extension. UNC will not recognize files as input data files unless they have a filename extension of UDT.

OUT   Uncertainty output filename extension. If the file is renamed, an extension of OUT is not required.

STA   Compiled CPIEM output filename extension. UNC expects this file to have an extension of STA, but it is not required.

UST   Output statistics filename extension. If the file is renamed, an extension of UST is not required.

PLT   WGNUPLOT filename extension. If the file is renamed, an extension of PLT is not required.

Getting Started

- Select an input uncertainty data set using the Input Uncertainty Data menu or select the New option under Input Uncertainty Data to enter data for a new data set. If a new data set is created, be sure to save the data set before moving on to the next step.

- Execute the program to generate the uncertainty data to be entered into CPIEM by choosing the Create Uncertainty File option under the Execute menu.

- Exit UNC and enter the output uncertainty data into CPIEM to get the necessary output files.

- Merge the multiple CPIEM output files into one large output file.

- Select a CPIEM output data set by choosing the Select CPIEM Uncertainty Output option under the Calculate/View Statistics menu to generate the statistics on the CPIEM output and to generate a graph of the output statistics.

Creating a New Input Data Set

Selecting the option of New under the Input Uncertainty Data menu brings up the following screen:

The user will enter a title for the input data file that contains at most 80 characters, and the total number of CPIEM factors that are to be included in the uncertainty analysis. Once these fields have been completed, the user should left click on the button labeled ADefine Factors@.

This brings up another screen for entering specific data for each CPIEM factor.

CPIEM Variables with Uncertainty ☒

| OK | | Cancel |

Enter Uncertainty Types for Each CPIEM Factor
Case Name Uncertainty Types will ignore the Variability Distribution type
The ENTER Key must be pressed to save data entered!

	Factor Name	Variability Dist.	Uncertainty Type
Par. 1		▾	▾

Ready

The user should enter the name for each CPIEM factor in the first column (name can be no more than 10 characters) and the corresponding model input variability distribution in the second column. For the model input variability distributions, distributions must be entered from the pull down menu that is accessed by left clicking on the arrow at the end of the box or by pressing the ENTER key and using the arrow keys. Left clicking on the desired distribution in the menu or pressing the ENTER key when the desired distribution is highlighted selects that distribution to be inserted into the box. The user then must decide on an uncertainty distribution to be used, and must add this distribution in the third column. If the case name uncertainty distribution is selected, the selected variability distribution is ignored by UNC. The uncertainty distributions are entered in the same manner as the variability distributions. Only valid choices will appear in the drop down menus for each of the last two columns. Once all information has been entered, the user should left click on the button labeled AOK@ to proceed to the next screen. Left clicking on the button labeled ACANCEL@ at any time will return the user to the first screen in the input process.

The user may also add or delete a CPIEM factor on this screen. Right clicking on any cell in the screen brings up a menu to allow the user to add or delete a CPIEM factor to the list. A new line will appear at the bottom of the list if the ADD option is selected. If the DELETE option is selected, the row in which the cursor is currently will be deleted.

The next screen is for entering the distributions for parameters for the CPIEM factors for which a continuous uncertainty distribution was chosen.

Continuous Uncertainty Distributions

OK Cancel

Enter Continuous Distributions and Parameter Values
The ENTER Key must be pressed to save data entered!

CPIEM Factor Parms.				Mean/Min	Std/Max
Factor1	Triangular	Min	▾		
Factor1	Triangular	Mode	▾		
Factor1	Triangular	Max	▾		

Ready

Only those CPIEM factors for which a continuous uncertainty distribution was selected will appear on this screen, but each factor will appear on multiple lines: one for the mean, geometric mean or minimum of the model input variability distribution; one for the mode of the model input variability distribution if the distribution was triangular; and one for the standard deviation, geometric standard deviation, or maximum. For each parameter, the user should select an uncertainty distribution from the drop down menu which may be accessed by left clicking on the arrow at the end of the box or pressing ENTER and using the arrow keys. Only valid selections will appear in the drop down menu: uniform, normal, arithmetic lognormal, and geometric lognormal. Then, for each selected uncertainty distribution for each parameter, the user should enter a mean, geometric mean, or minimum for the corresponding distribution under the column AMean/Min@, and a standard deviation, geometric standard deviation, or maximum under the column AStd/Max@:

- Uniform: Mean/Min = minimum,   Std/Max = maximum

- Normal: Mean/Min = mean,   Std/Max = standard deviation

- Arithmetic Lognormal: Mean/Min = mean,   Std/Max = standard deviation

- Geometric Lognormal: Mean/Min = geom. mean,   Std/Max = geom. standard deviation

The user may set a parameter to be a constant (no uncertainty) by selecting a uniform distribution and setting the maximum equal to the minimum. Once all columns have been

completed, the user should left click on the button labeled AOK@ to proceed to the next screen. If there were no CPIEM factors for which a continuous uncertainty distribution was selected, this screen will not appear.

The next screen is for entering the sets of parameters for the CPIEM factors for which a discrete uncertainty distribution was chosen.

```
┌──────────────────────────────────────────────────────────────────────┐
│ Discrete Uncertainty Distributions                                [X] │
│                                                                        │
│         ┌──────────────┐              ┌──────────────┐                 │
│         │     OK        │              │   Cancel      │                │
│         └──────────────┘              └──────────────┘                 │
│       Enter Sets of Comma Delimited Parameter Values Seperated by      │
│                         Semi-colons                                    │
│        The final set of Paremeter Values must be followed by a         │
│                         Semi-colon!                                    │
│          The ENTER Key must be pressed to save data entered!           │
│    ┌──────────────────────────────────────┬────────────────────┐      │
│    │                                       │                    │      │
│    │          CPIEM Factor Parms.          │                    │      │
│    │                                       │                    │      │
│    ├─────────┬────────────┬────────────────┴────────────────────┤      │
│    │ Factor1 │ Triangular │   Min,Mode,Max;                     │      │
│    │         │            │                                     │      │
│    │                                                             │      │
│    │                                                             │      │
│    │                                                             │      │
│    │                                                             │      │
│    │  ◄ ─────────────────────────────────────────────────── ►   │      │
└──────────────────────────────────────────────────────────────────────┘
```

Only those CPIEM factors for which a discrete uncertainty distribution was selected will appear on this screen. Each line will list a factor and the uncertainty distribution that was selected for the given factor. For each factor, the user should enter a set of parameters in the column ASets of Parameters@ with each parameter value in the list separated by a comma, and each set of parameters separated by a semicolon. The list of parameter sets must also end with a semicolon. The number and type of parameters the user should enter is indicated in the third column of the screen (i.e., Amean,std;@ indicates two values and Amin,mode,max;@ indicates three values). The user may enter as many sets of parameters as desired provided that at least two parameter sets are entered. If the user does not enter enough values, an error message will appear. The user must then press the ENTER key to save the entered list of parameters. Once this column has been completed, the user should left click on the button labeled AOK@ to proceed to the next screen. If there were no CPIEM factors for which a discrete uncertainty distribution was selected, this screen will not appear.

For each discrete uncertainty distribution, sets of parameter values may be repeated. This allows different sets to have different uncertainty probabilities. For example, for the triangular case, entering

$$1,2,3;1,2,3;2,4,5;$$

corresponds to assigning a 2/3 probability to the triangular distribution with min = 1, mode = 2, max = 3 and assigning a 1/3 probability to the triangular distribution with min = 2, mode = 4, max = 5. (1,2,3 was entered twice and 2,4,5 was entered once).

The next screen is for entering the parameters and sample size for the model input variability distributions for the CPIEM factors for which a default uncertainty distribution was chosen.

Default Uncertainty Distributions

OK			Cancel	

Enter Original Variability Distribution Parameters and Sample Sizes
The ENTER Key must be pressed to save data entered!

CPIEM Factor Parms.			Parameter Value
Factor1	Triangular	Min	
Factor1	Triangular	Mode	
Factor1	Triangular	Max	
Factor1	Triangular	Sample Size	

Only those model input variability distributions for CPIEM factors for which a default uncertainty distribution was selected will appear on this screen, but each model input variability distribution will appear on multiple lines: one for the mean, geometric mean, or minimum of the variability distribution; one for the mode of the variability distribution if the distribution was triangular; one for the standard deviation, geometric standard deviation, or maximum of the distribution; and one for the sample size. Under the column AParameter Value,@ the user should enter the value of the parameter indicated in the previous column: the mean, geometric mean, or minimum; the mode for triangular variability distributions; the standard deviation, geometric standard deviation, or the maximum; and the sample size. The sample size, S, defines how many times the user would like the UNC program to sample from the variability distribution.

For each simulation, the program will sample S times from the user-specified variability distribution and use those S values to compute a new set of parameter values. For example, for a uniform distribution with min=1, max=3, sample size=8, eight values will be selected randomly from the uniform distribution on the interval from 1 to 3 and the set of parameter values for the first CPIEM simulation will be the minimum and maximum of those eight values. Another set of eight values will be randomly selected to give the set of parameter values for the second simulation.

The user should press ENTER after entering values in each cell to ensure that the entered values are saved. Once the column has been completed, the user should left click on the button labeled AOK@ to proceed to the next screen. If there were no variability distributions for CPIEM factors for which a default uncertainty distribution was selected, this screen will not appear.

The next screen is for entering the data set names for the CPIEM factors for which a case name uncertainty distribution was chosen.

Case Name Uncertainty Distributions		✗
UN		□ ✗
Input		

OK		Cancel	

Enter Case Names Seperated by Semi-colons
The final Case Name must be followed by a Semi-colon!
The ENTER Key must be pressed to save data entered!

CPIEM Factor	
Factor1	

Ready

Only those CPIEM factors for which a case name uncertainty distribution was selected will appear on this screen. Each line will list a factor name and, for each factor, the user should enter a set of data set names (case names) in the second column with each name in the list separated by a semicolon. The list must also end with a semicolon. The user may enter as many data set names as desired as long as at least two data set names are entered. If the user does not enter enough names, an error message will appear. The user must then press the

ENTER key to save the entered list of names. Once this column has been completed, the user should left click on the button labeled AOK@ to proceed to the next screen. If there were no CPIEM factors for which a case name uncertainty distribution was selected, this screen will not appear.

For each case name uncertainty distribution, sets of case names may be repeated. This allows different distributions to have different uncertainty probabilities. For example, suppose the possible distributions for a given CPIEM factor have the case names NORMAL1, NORMAL2, and UNIFORM. Entering

NORMAL1; NORMAL2; NORMAL2; UNIFORM

corresponds to assigning a 1/4 probability to the NORMAL1 distribution, a 2/4=1/2 probability to the NORMAL2 distribution, and a 1/4 probability to the UNIFORM distribution.

Once all screens have been completed, the program will return to the initial input screen, and the user should left click on the button labeled AOK@. The user should then save the file by selecting the Input Uncertairity Data menu and the selecting the Save As option. A standard Windows file selection window will appear to allow the user to select the directory for which the data set should be saved. When entering the data set name, an extension need not be included since UNC will automatically select an extension of UDT. Files without an extension of UDT will not be recognized by UNC as input data files.

The user may then select the Create Uncertainty File option under the Execute menu to generate the uncertainty input data for use with CPIEM.

Modifying an Input Data Set

To modify an input data set, the user must first load a data file by choosing the Select option under the Input Uncertainty Data menu. A standard Windows file selection window will appear to allow the user to find the desired subdirectory and data file. Once the user has selected an input data file, the screen will be blank, but the status bar will show that the file has been loaded and will show the name of the loaded file. The user should then choose the Modify option under the Input Uncertainty Data menu. This will bring up the initial input screen as though a new input data set were being created, except that the fields for title and total number of CPIEM factors are already completed. Title changes must be made here. Increases in the number of CPIEM factors may be made here or on the next screen, but decreases in the total number of CPIEM factors must be made on the next screen. The screens then proceed in the same manner as when creating new data sets. To change cell contents for which pull down menus are not available, click in the cell and type the new contents. The user must press ENTER after modifying cell contents without drop down menus to ensure that the information is saved.

Executing an Input Data Set

To execute an input data set, the user must first have loaded a data file by choosing the Select option, and possibly the Modify option, under the Input Uncertainty Data menu. A standard Windows file selection window will appear to allow the user to find the desired subdirectory and data file. Once the user has selected an input data file, the screen will be blank, but the status bar will show that the file has been loaded and will show the name of the loaded file. The user should then choose the Create Uncertainty File option under the Execute menu. This will bring

up a window with two options for the user to select: to use the midpoint of each slice in the Latin HyperSquare calculations or to use a random point from each slice; and how many simulations should be run. To use the midpoint of each slice, the user should put a check in the box by left clicking on the center of the box. To use a random point, the user should make sure that the box is not checked. Use of the midpoint or a random point will only affect the calculations for those factors for which a continuous uncertainty distribution was defined. In general, the user is recommended to use the midpoint option when the number of simulations is low (e.g., less than 50). Using the midpoint option avoids unrepresentative simulations such that the low end, or high end, of each slice is always selected. Next, the user should enter the desired number of simulations.

```
┌─────────────────────────────────────────────────────────────────────┐
│ 🏠 UNC Uncertainty Program for CPIEM                         [_][□][×] │
│ Input Uncertainty Data      Execute      Calculate/View Statistics  Options │
│ ┌───────────────────────────────────────────────────────────────┐   │
│ │ Uncertainty Run Options                                   [×]  │   │
│ │                                                               │   │
│ │   ┌─────────────────────────────────────────────┐            │   │
│ │   │Use Midpoint in Latin HyperSquare Calculations:│      □     │   │
│ │   └─────────────────────────────────────────────┘            │   │
│ │                                                               │   │
│ │   Number of Simulations:       ┌──────────┐                   │   │
│ │                                │100       │                   │   │
│ │                                └──────────┘                   │   │
│ │                                                               │   │
│ │                      ┌──────┐      ┌────────┐                 │   │
│ │                      │  OK  │      │ Cancel │                 │   │
│ │                      └──────┘      └────────┘                 │   │
│ │                                                               │   │
│ └───────────────────────────────────────────────────────────────┘   │
│                                                                     │
│ Ready                              Sample.udt                       │
└─────────────────────────────────────────────────────────────────────┘
```
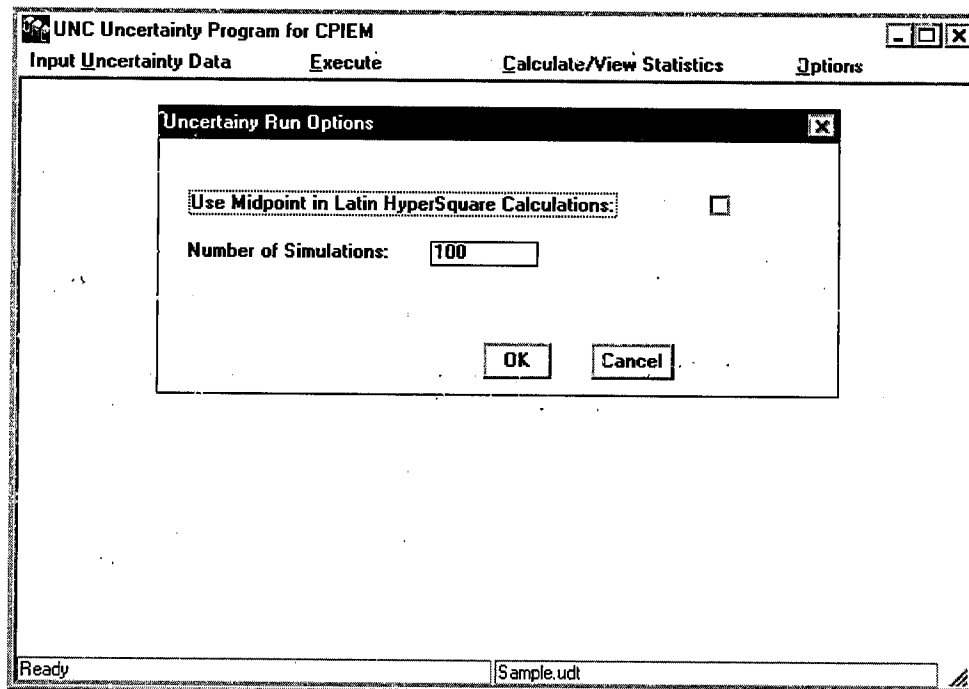
The user may then execute the uncertainty data generation by left clicking on the OK button or may abort the process by left clicking on the CANCEL button. Once the program has completed the uncertainty data generation, the uncertainty output will appear in a new screen in Notepad. The uncertainty output file will automatically be given the same name as the uncertainty input file except with an extension of OUT. The file is automatically saved under this name, but the user may save the file under another name by selecting the Save As option under the File menu.

The user must then enter, by hand, the information from the uncertainty output file into CPIEM in order to obtain a CPIEM output file on which to generate statistics. The uncertainty output file is a semicolon delimited ASCII file. The user may best view the output by importing the file into EXCEL and specifying that the columns are semicolon delimited. Once the file has been imported, the user should use Excel's Copy, Paste Special, and Transpose options under the Edit menu to reorganize the output for easier interpretation.

If uncertainty distributions have not been specified for any level 3 CPIEM input factors, then an uncertainty analysis of the level 1-2 total indoor exposure concentration or dose is carried out by

running the CPIEM level 1-2 module N times, using each of the N sets of parameters generated by UNC. The N output distributions are combined, and the second part of the UNC program is used to generate the uncertainty distributions of the total indoor exposure concentration or dose, as discussed below.

If uncertainty distributions have been specified for some level 3 CPIEM factors, then the uncertainty analysis is carried out by running the CPIEM level 3 module followed by the CPIEM level 12 module N times. In the first set of simulations, the first set of level 3 input factors generated by UNC is used for the level 3 CPIEM module, and those level 3 outputs (i.e., hourly or daily indoor concentration distributions) are combined with the first set of level 1-2 input factors generated by UNC to provide inputs for the level 1-2 CPIEM module. The level 3 module may need to be run for several microenvironments. This whole process is repeated N times. The N level 1-2 output distributions are combined, and the second part of the UNC program is used to generate the uncertainty distributions of the total indoor exposure concentration or dose, as discussed below. If desired, the N level 3 output distributions can be combined, and the second part of the UNC program used to generate the uncertainty distributions of the hourly or daily average indoor concentrations.

After running CPIEM with the uncertainty output for the necessary number of times, the user must copy all of the level 12 CPIEM output files into one file, and, if level 3 uncertainty analyses are required, copy all of the level 3 CPIEM output files into another file. The easiest way to accomplish this is with the following DOS command:

<p style="text-align:center">copy *.STE FILENAME.STA,</p>

where *.STE are the CPIEM output files and FILENAME.STA is the desired name of the new output file. The UNC program expects the extension of the compiled CPIEM output file to be STA.

The user may then choose the Select CPIEM Uncertainty Output option under the Calculate/View Statistics menu to generate the statistics on the CPIEM output.

Generate Statistics and Graph of CPIEM Output

To generate statistics on the CPIEM output, the user must first select a CPIEM output file by choosing the Select CPIEM Uncertainty Output under the Calculate/View Statistics menu. Choosing this option brings up a standard Windows file selection window which lists all available files with an extension of STA in the current working directory. Only files with a STA extension may be used. Selection of a file causes the generation of the output statistics on the chosen CPIEM output file and brings up a window showing the generated output statistics in Notepad. The program generates the mean, standard deviation, median, minimum, maximum, and the 2.5th and 97.5th uncertainty percentiles for all of the statistics for either the TOTALS column from a level 1-2 analysis or the HOURLY and DAILY columns from a level 3 analysis. The program automatically detects the CPIEM level. The file of output statistics will automatically be given the same name as the CPIEM output file, except that the extension is changed to UST. The file is automatically saved under this name.

When the window of output statistics is closed, another window pops up asking if the user would like to view a graph of the output statistics. When the user chooses to view the graph of output statistics, a graph of the output statistics is generated using WGNUPLOT. This graph plots the median, 2.5th, and 97.5th percentiles of the output variability distribution, based on the

percentiles for each of the N uncertainty simulations. The median curve summarizes the output variability distribution (at the median level of uncertainty). The 2.5th and 95.5th curves provide a 95 % uncertainty envelope for the variability distribution. For a level 3, the user may choose to view either the daily or hourly average graphs or both. The file created for WGNUPLOT will be named the same as the statistics file except with an extension of PLT (for level 1-2 totals or level 3 daily averages) or PLTH (for level 3 hourly averages). These files can also be used directly with the WGNUPLOT program (WGNUPL32.EXE) to produce the graphs from outside the UNC program.

WGNUPLOT (Copyright 8 1986 - 1993, 1998, 1999 Thomas Williams, Colin Kelley and many others) is the graphing program used by UNC. UNC creates data files for WGNUPLOT.

Once the statistics have been generated, the user can view the statistics file and the corresponding graph by choosing the Select Statistics File to View under the Calculate/View Statistics menu. Choosing this option brings up a standard Windows file selection window which lists all available files with an extension of UST in the current working directory. Selection of a file opens that file in Notepad as was done when the statistics were calculated. After the Notepad window is closed, the user will again be offered the option of viewing graphs of the output statistics.

To copy the plot into Word or other Office products, right click on the graph, select "Copy to clipboard," open the Word document, and then use the paste command to copy from the clipboard into your document.

Verification Tests

The UNC module is used to analyze the sensitivity of the CPIEM output variability distributions to various parameters. UNC has two functions: (1) it provides an array of values with a certain distribution for a given parameter to be used as input to CPIEM; and (2) it summarizes the output from successive calculations (runs) of CPIEM into concise tables and charts. This greatly simplifies the assessment of the sensitivity. These two functions will be verified and discussed separately. Note that this test is a verification that the UNC code correctly makes calculations, rather than being a validation that the combined CPIEM and UNC modules correctly represent the uncertainty of real world indoor air exposures.

a. Generation of CPIEM Input Parameters

A calculation using CPIEM requires certain inputs. UNC generates distributions of input values that are suitable for analyzing, for example, the sensitivity of CPIEM to the precise value of these parameters. Suppose an input is the mean of an exponential distribution and we are interested in the effect of varying it according to different uncertainty distributions. UNC provides the choice of four different continuous distribution types for a CPIEM input parameter: (1) normal; (2) lognormal specifying arithmetic mean and standard deviation; (3) lognormal specifying geometric mean and standard deviation; and (4) uniform between two limits. The distributions for the possibilities (2) and (3) are equivalent but the different specifications are provided for convenience. The following test verifies the generation of data from these distributions.

Each input value for CPIEM will be designated for a simulation and UNC will generate a user-specified number, n, of these input values. The specified distribution of the parameter (in this example case the mean of exponential distribution) is divided into n slices of equal probability. A

value for each slice is either taken as the probability midpoint, or as a random point in that slice interval. In the following we have made eight calculations with UNC to provide eight sets of 1000 potential values for the mean of the exponential distribution. Each of the distributions is requested twice, once with the slice midpoint and one with a random point in the slice.

The parameter distributions are straightforward and n=1000 values should accurately represent the profiles of the distributions. The theoretical frequency for any interval may be calculated and compared with the observed frequency using UNC.

i. . Normal distribution with mean=6 and standard deviation=2 is specified. Since the simulated values are to be used as means for an exponential distribution, they must be positive and the normal curve is truncated at zero. This omits 0.135% of the true distribution and would correspond to one or two points out of 1000. This truncation effectively renormalizes the distribution so that the positive portion will have 100% and all the slices are moved upward slightly. The resulting curves are shown in Figures D-1 and D-2 along with tables showing the observed and theoretical frequencies of various bins. The bin label is the upper bound and the top bin contains all values greater than 12. There is essentially no difference between the theoretical and observed bin frequencies.

Bin	Frequency	Normal
0-1.5	11	10.87
1.5-3	55	54.58
3-4.5	160	159.82
4.5-6	273	273.37
6-7.5	274	273.37
7.5-9	160	159.82
9-10.5	55	54.58
10.5-12	11	10.87
over 12	1	1.35
Total	**1,000**	**998.63**
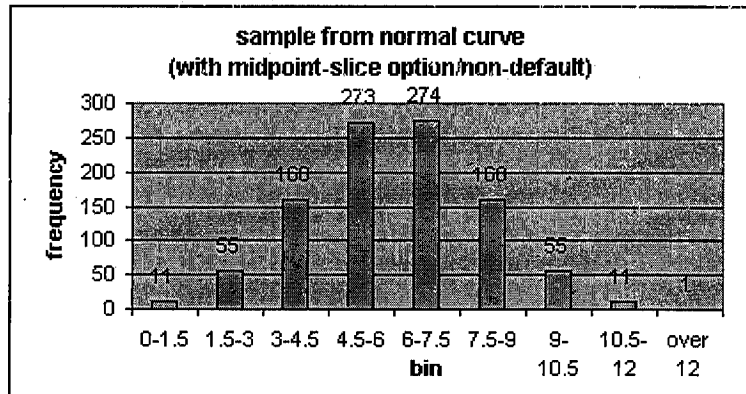
Figure D-1 Sample from Normal Distribution with Midpoint Slice Option

Bin	Frequency	Normal
0	11	10.87
1.5	55	54.58
3	160	159.82
4.5	273	273.37
6	274	273.37
7.5	160	159.82
9	55	54.58
10.5	11	10.87
12+	1	1.35
Total	**1,000**	**998.63**
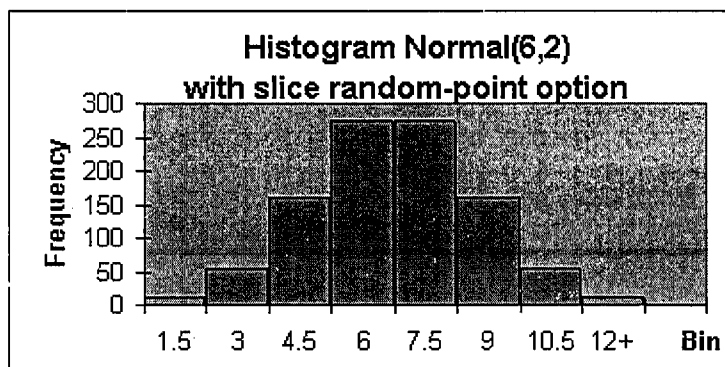
Figure D-2 Sample from Normal Distribution with Random-Point Slice Option

ii.   Lognormal curve with arithmetic mean=4 and standard deviation=2. For a lognormal distribution, the logarithm of the variable has a normal distribution. Thus, the variable must be positive and there is no need to truncate the distribution. This also provides a simple way to evaluate the frequency profile by simply choosing the bin boundaries logarithmically so that the theoretical frequency distribution follows the normal, bell-shaped curve. For the arithmetic parameters given, the geometric mean is 4/sqrt(5/4)= 3.57771, and the logarithm of this is the mean of the logarithms of the variables. Thus, the logarithm of the geometric mean was chosen as one of the bin boundaries and the boundaries were set to vary by a factor of sqrt(2). The results for these calculations are shown in Figures D-3 and D-4. Again we see that there is essentially no difference between the theoretical and observed frequencies. Any difference may be due to roundoff or, in the case of the random midpoint option, sampling variability.

iii. Lognormal curve with geometric mean=3.57771 and geometric standard deviation=1.60381. See Figures D-5 and D-6. An expression for the geometric mean from the arithmetic terms is given above. The geometric standard deviation, when the arithmetic mean is 4 and standard deviation is 2, is given by exp{sqrt[ln(5/4)]}= 1.60381, the value indicated. So, this is the same distribution as above (ii). Thus, we again chose the bin boundaries as above and we find essentially the same frequencies. The random point option for this distribution gives a perfectly symmetric distribution, like the theoretical. There is a random distribution of points near the bin boundaries, but the profile should be very close to the theoretical one, and sometimes exactly symmetric, as is here observed.

iv.   Uniform with minimum=1 and maximum=5. See Figures D-7 and D-8. This is an exceedingly simple distribution, but there is a slight difference in the two point choices. Presumably, one of the random point choices rounds to 1.4000 and is counted in the first bin. For the midpoint choice there is no problem. Each of the points is of the form 1.002+0.004(I-1), where I is an index between 1 and 1000. There is no point too near a boundary and each of the ten bins has an equal frequency of 100.

In summary, we have verified that UNC does accurately represent each of the selected distributions.

Bin	Frequency	LogNormal
	2	1.67
0.894427	12	12.20
1.264911	57	57.27
1.788854	160	160.43
2.529822	269	268.43
3.577709	268	268.43
5.059644	161	160.43
7.155418	57	57.27
10.11929	12	12.20
14.31084	2	1.67
Total	**1,000**	**1,000**
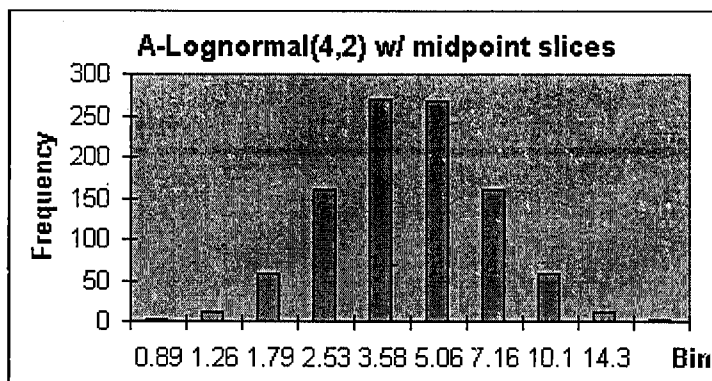
Figure D-3 Sample from Lognormal Distribution Specified with Arithmetic Mean and Standard Deviation, with Midpoint Slice Option

Bin	Frequency	LogNormal
	2	1.67
0.894427	12	12.20
1.264911	57	57.27
1.788854	160	160.43
2.529822	269	268.43
3.577709	268	268.43
5.059644	160	160.43
7.155418	58	57.27
10.11929	12	12.20
14.31084	2	1.67
Total	**1,000**	**1,000**
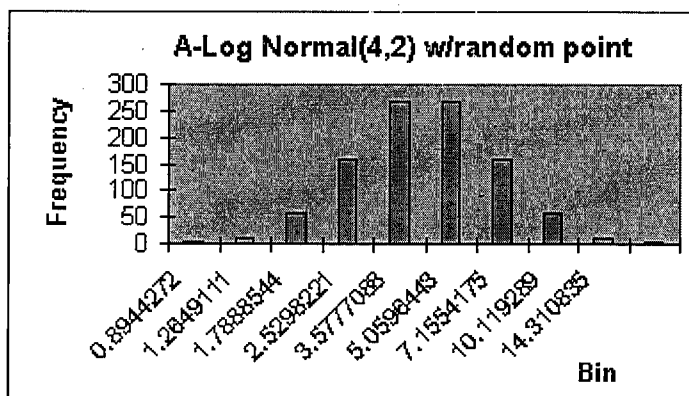
Figure D-4 Sample from Lognormal Distribution Specified with Arithmetic Mean and Standard Deviation, with Random-Point Slice Option

Bin	Frequency	LogNormal
	2	1.67
0.894427	12	12.20
1.264911	57	57.27
1.788854	160	160.43
2.529822	269	268.43
3.577709	268	268.43
5.059644	161	160.43
7.155418	57	57.27
10.11929	12	12.20
14.31084	2	1.67
Total	**1,000**	**1,000**
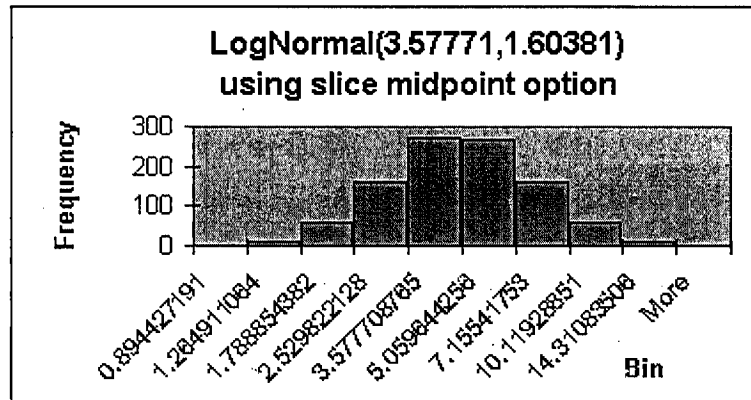
Figure D-5 Sample from Lognormal Distribution Specified with Geometric Mean and Standard Deviation, with Midpoint Slice Option

Bin	Frequency	LogNormal
	1	1.67
0.894427	13	12.20
1.264911	57	57.27
1.788854	161	160.43
2.529822	268	268.43
3.577709	268	268.43
5.059644	161	160.43
7.155418	57	57.27
10.11929	13	12.20
14.31084	1	1.67
Total	**1,000**	**1,000**
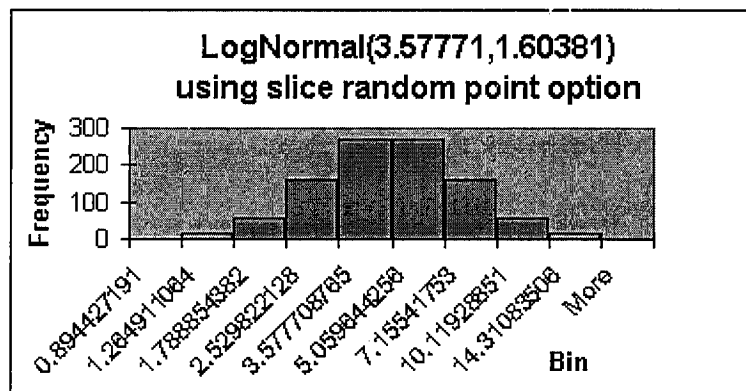
Figure D-6 Sample from Lognormal Distribution Specified with Geometric Mean and Standard Deviation, with Random-Point Slice Option

Bin	Frequency	Uniform
1.4	101	100
1.8	99	100
2.2	100	100
2.6	100	100
3.0	100	100
3.4	100	100
3.8	100	100
4.2	100	100
4.6	100	100
5.0	100	100
Total	**1,000**	**1,000**
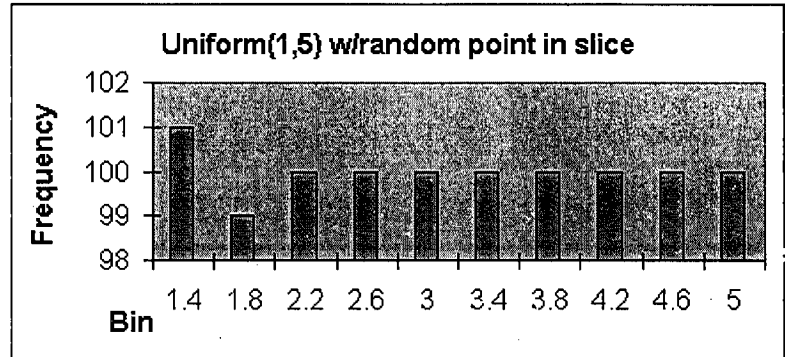
Figure D-7 Sample from Uniform Distribution with Random-Point Slice Option

Bin	Frequency	Uniform
1.4	100	100
1.8	100	100
2.2	100	100
2.6	100	100
3.0	100	100
3.4	100	100
3.8	100	100
4.2	100	100
4.6	100	100
5.0	100	100
Total	**1,000**	**1,000**
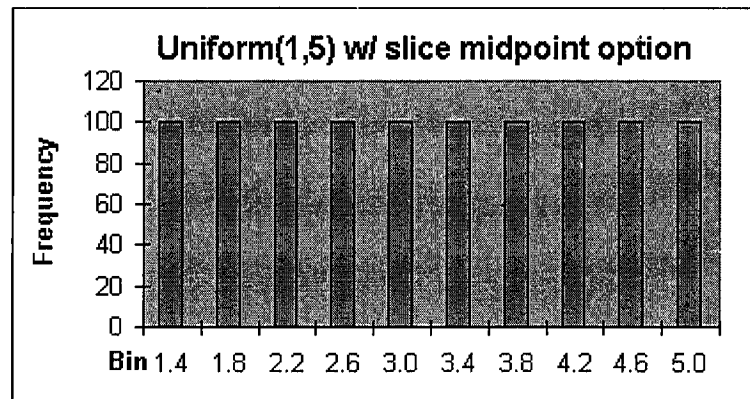
Figure D-8 Sample from Uniform Distribution with Midpoint Slice Option

b. Using UNC to Summarize CPIEM Output

The second group of verification tests checks the combined operations of UNC and CPIEM. In each case, UNC is used to generate up to 20 sets of CPIEM input parameters, CPIEM generates output variability distributions based on these inputs, and then UNC generates the summary statistics and graphs of the uncertainty and variability. For this group of verification tests, the midpoint slice option for the LHS was used for each case.

For each of these calculations we consider hypothetical residential indoor concentrations and examine the variability distribution for the time-weighted daily average total exposure from the residential micro-environment only. For identification purposes only, the indoor pollutant is called formaldehyde. The inputs, however, do not necessarily correspond to formaldehyde data. For these tests a special version of CPIEM was used in which the weights for all activity patterns with any time spent in a non-residential microenvironment were reset to zero. Thus of the 2,962 activity patterns, 2,845 were given zero weight and the remaining 117 cases with all 24 hours spent in residence were given their original (positive) weights. In each CPIEM run, 5,000 trials were used, so that 5,000 activity patterns were selected at random with replacement. Of those 5,000, only those cases where the selected activity pattern was one of the 117 with all time spent in residence would be given a positive weight. (With significantly fewer than 5,000 trials there is a high probability that none of those 117 activity patterns will be selected, which will cause CPIEM to terminate abnormally because of a divide by zero error.) It follows that for this special version of CPIEM, the output variability distribution for each CPIEM run should match the selected input distribution if CPIEM is working correctly. More precisely, one should expect a good match but not an exact match since 5,000 trials were used instead of hypothetically infinitely many trials.

The calculations are divided into two sets: (1) the residential indoor concentration distribution is a lognormal distribution (CPIEM requires the arithmetic mean and standard deviation as parameters); and (2) the residential indoor concentration distribution is a mixture of normal distributions. The parameters of the distribution were assigned various uncertainty distributions using the UNC module. For each case in Set 1, the mean values of the mean and standard deviation parameters were 2 and 1, respectively. Thus for each case in Set 1 the output variability distribution at the median level of uncertainty should be approximately equal to a lognormal(2,1) distribution.

We shall first describe the various cases and present the graphical results (from UNC) in each case. Table D-1, described at the end of this section, compares the uncertainty/variability summary statistics from UNC with the values computed using statistical software.

i.   Calculation Set 1, Case a: In these calculations no uncertainty was assigned to the lognormal mean and standard deviation parameters. Only the CPIEM random seed was allowed to vary across the 20 CPIEM runs. Thus the uncertainty for this case relates only to the variation of the random number seed and there should be little difference in the results. The results are shown in Figure D-9. As expected, the uncertainty of the variability distribution is small.
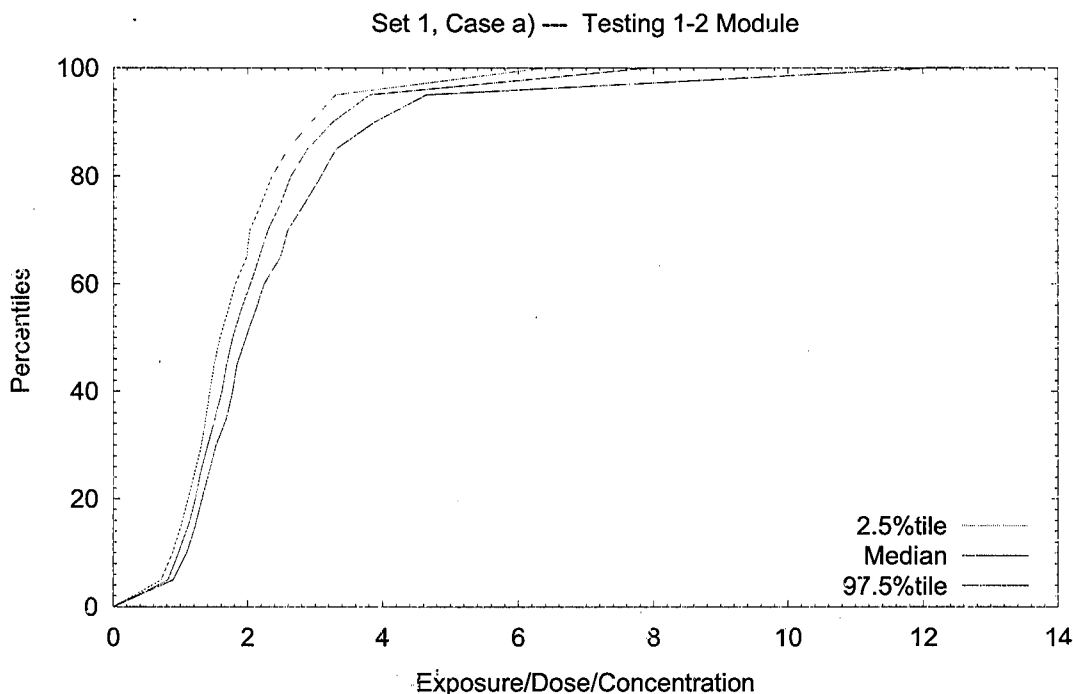
11:43 02/22 2002

Set 1, Case a) — Testing 1-2 Module

Figure D-9 Results for Set 1, Case a: Lognormal Distribution with No Parameter Uncertainty, Varying Random Seed

ii.   Calculation Set 1, Case b: In these calculations the CPIEM random number seed is constant across the 20 runs, and the parameter variation is from the default uncertainty distribution based on a sample size of 1000. With the random seed constant, CPIEM selects the same set of activity patterns in each run, although the simulated exposure distributions will vary. Because a large sample size was chosen for the default uncertainty distributions, there are only small variations in the input means and standard deviations. The uncertainty in the distribution is shown in Figure D-10.

iii. Calculation Set 1, Case c: In these calculations the CPIEM random number seed is constant across the 20 runs, and the parameter variation is from the default uncertainty distribution based on a sample size of 10. Because a small sample size was chosen for the default uncertainty distributions, there are larger variations in the input means and standard deviations compared to case b. The uncertainty in the distribution is shown in Figure D-11. Both cases (b) and (c) appear quite similar; but note that the concentration variables are plotted on very different scales. There is significantly more variation in case (c) than in the first two cases, as expected.

11:58 02/22 2002

Set 1, Case b) — Testing 1-2 Module
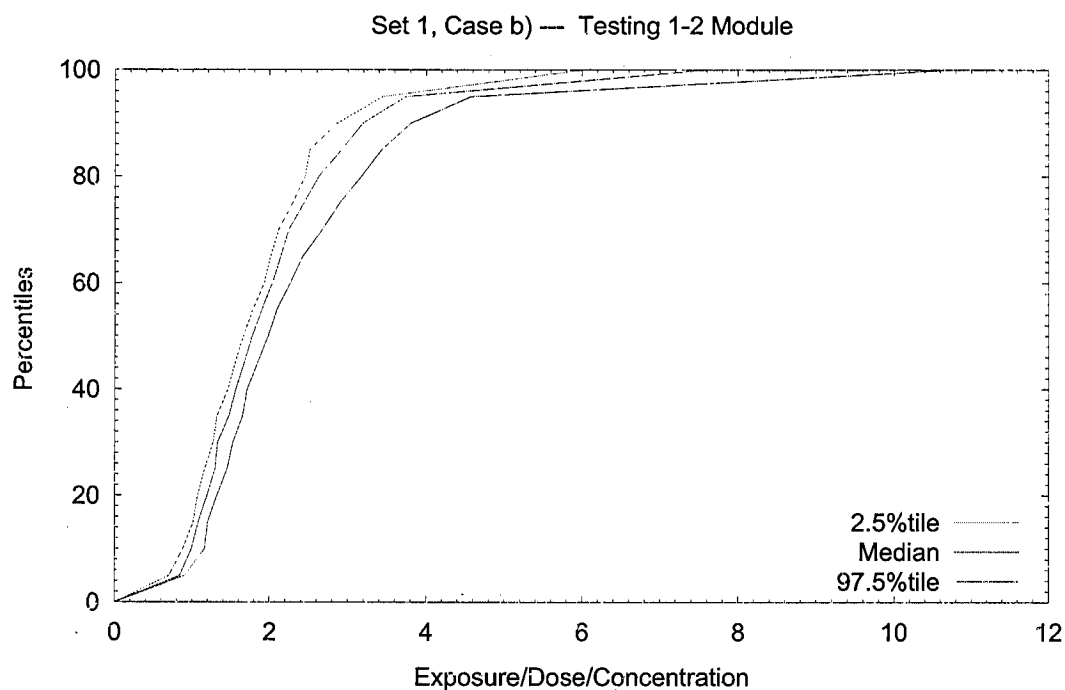
Figure D-10 Results for Set 1, Case b: Lognormal Distribution with Default Paramet r
Uncertainty, Uniform Random Seed, Sample Size = 1000

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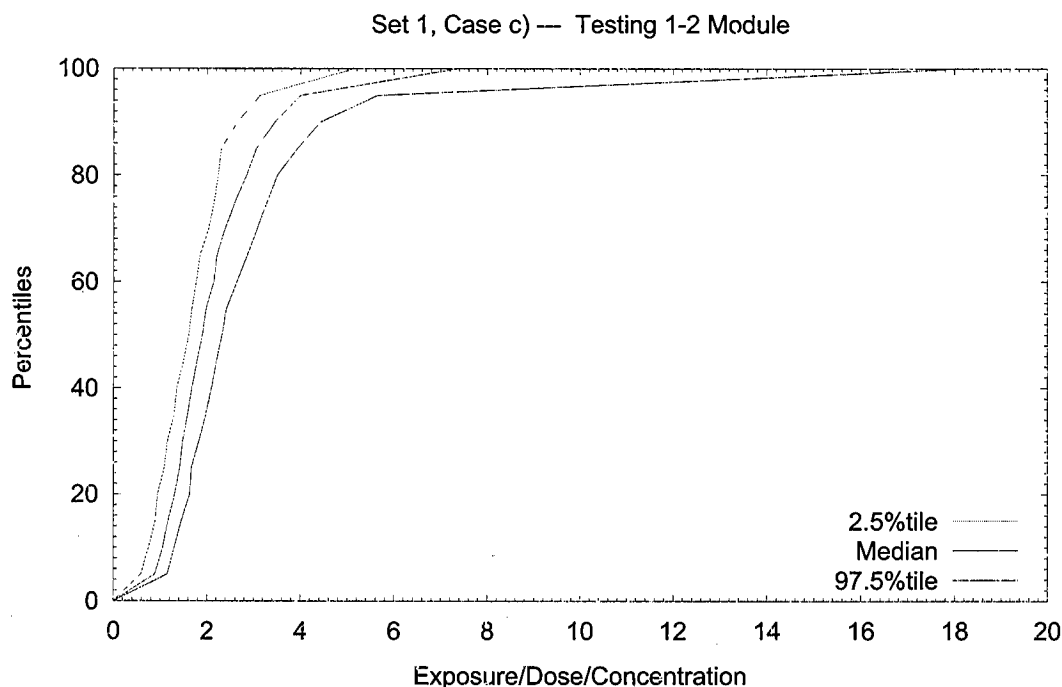
Figure D-11 Results for Set 1, Case c: Lognormal Distribution with Default Parameter Uncertainty, Uniform Random Seed, Sample Size = 10

iv.   Calculation Set 1, Case d: For these 20 calculations the mean of the distribution is uniformly distributed between 0 and 4 while the standard deviation is chosen from a normal distribution with mean value 1 and standard deviation 0.01. The distribution variation is shown in Figure D-12. The variation in the distributions is significantly wider than any of the first three sets of calculations. Note that there was one simulated exposure/concentration of 29.34 units, a very large value.

v.   Calculation Set 1, Case e: For these 20 calculations the mean of the distribution is requested to be uniformly distributed between –3 and 4, with the standard deviation having the same distribution as case (d). Since the mean parameter is the mean of a lognormal distribution, UNC chooses only positive values and, in fact, it chooses exactly the same 20 values as case (d). Since the standard deviation of the standard deviation is so small, 0.01, all the values for both these cases are essentially 1.0 and these two cases would have approximately the same inputs. If the numbers of UNC simulations and CPIEM trails had both been hypothetically infinite, then the output uncertainty/variability distributions for cases (d) and (e) should be identical. This result is verified in Figure D-13. Note however that different x scales were used. The second calculation has a maximum exposure of only 16.73, but the results for cases (d) and (e) are almost equivalent (much closer than they appear).

vi.   Calculation Set 1, Case f: For these 20 calculations the mean and standard deviations are taken from rather wide normal distributions, (2,1) and (1,0.5) respectively. The results for the variation in the distributions for these are shown in Figure D-14. As expected, the wide uncertainty distributions for the inputs lead to broad distributions for the resulting outputs. Both the mean and standard deviation for a lognormal distribution are positive values and

both these distributions are truncated appropriately by the UNC module. The mean of all the calculations is pushed a little above 2.0 (to 2.09) because of the truncation of the distribution of the mean parameter.

13:03 02/22 2002

Set 1 Case d) — Testing 1-2 Module
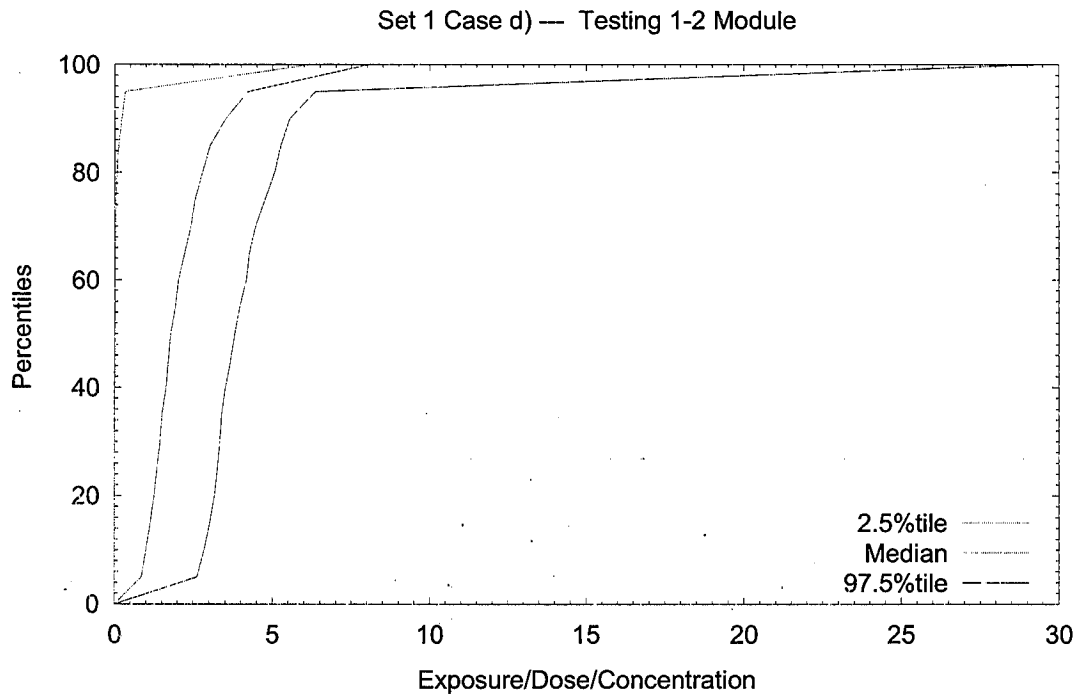
Figure D-12 Results for Set 1, Case d: Lognormal Distribution, with Mean Uniform (0,4), Standard Deviation Normal (1.0, 0.1)
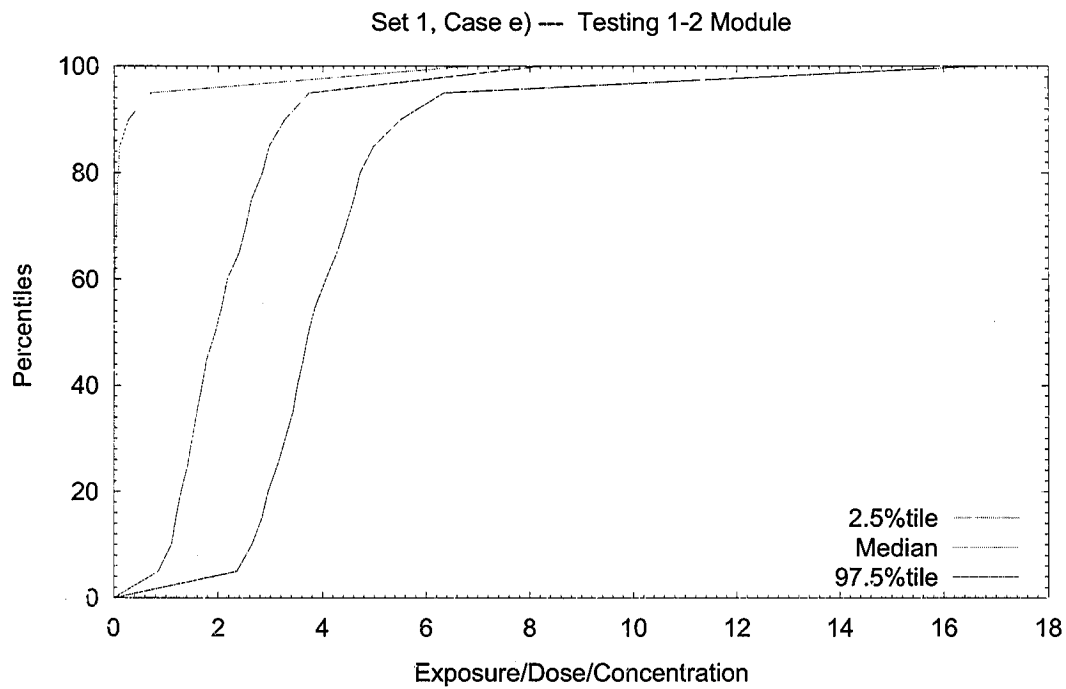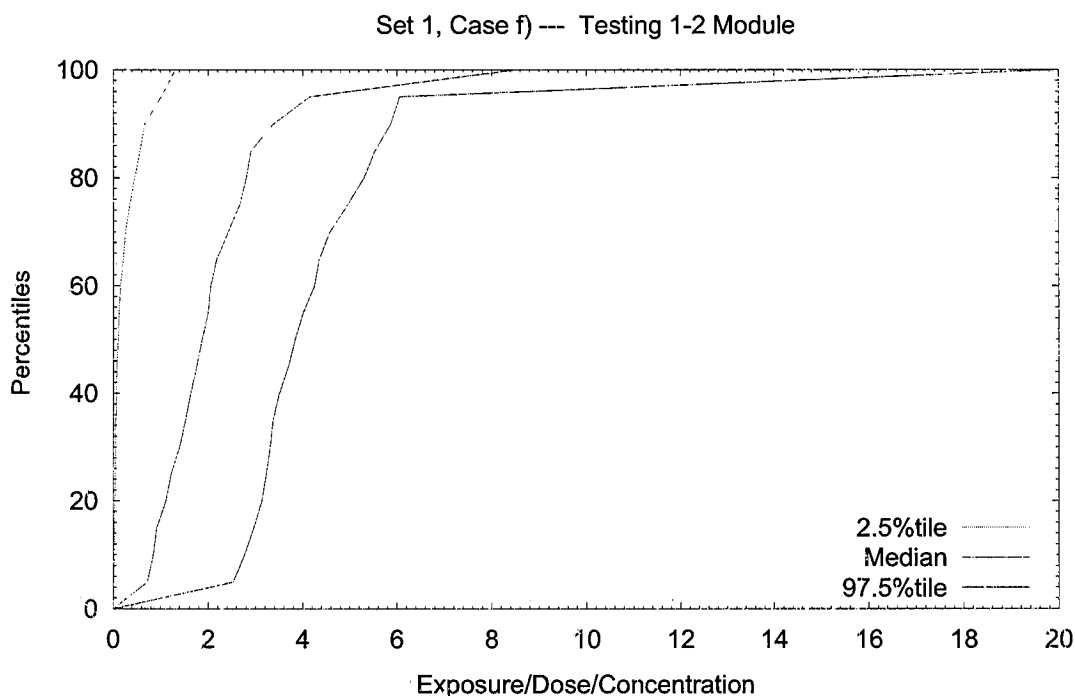
13:04 02/22 2002

Figure D-13 Results for Set 1, Case e: Lognormal Distribution with Mean Uniform (-3,4), Standard Deviation Normal (1, 0.1)

13:05 02/22 2002

Set 1, Case f) --- Testing 1-2 Module

Figure D-14 Results for Set 1, Case f: Lognormal Distribution with Mean Normal (2,1), Standard Deviation Normal (1, 0.5)

vii. Calculation Set 2, Case a: For these calculations, only four CPIEM runs are performed. They are each normal distributions (with means of 4, 6, 8, and 10), each with a standard deviation of 1. This yields a wide variation in the distributions as shown in Figure D-15. The exposure distribution at the 97.5%-tile of uncertainty is equal to the exposure distribution at the 2.5%-tile plus 6 units. In fact, the detailed results of the individual calculations show that the percentiles for the mean 6 are 2 units above the percentiles for mean 4; the mean 8, 4 units above the mean 4; and the mean 10, 6 units above the percentiles for mean 4. This is the expected pattern because the four input distributions have almost identical shapes apart from their location parameters (which differ by multiples of 2). The four input distribution functions are not exactly parallel because of the truncation to positive concentration values, which has a small impact on the normal(4,1) case, but even smaller effects on the other three normal distributions. With the random point option for the LHS and/or using different random number seeds for each CPIEM run, the three curves in Figure D-15 would not appear so parallel. The expected output pattern (in the limiting case of infinitely many trials) for this normal mixture is a truncated normal(4,1) distribution at the 2.5 % uncertainty, a truncated normal(7,1) distribution at the 50 % uncertainty, and a truncated normal(8,1) distribution at the 97.5 % uncertainty. The simulation results match this pattern.

viii. Calculation Set 2, Case b: For these calculations, 4 CPIEM runs with normal distributions are again performed. This time the first run has mean 4, and the next three all have mean equal 8; all have a standard deviation of 1. This case corresponds to a mixture of normal distributions where the normal(4,1) distribution has uncertainty weight 0.25 and the

normal(8,1) distribution has uncertainty weight 0.75. To allow some variation in the last three calculations (8,1), they were given different random number seeds. The results for this case are shown in Figure D-16. The 2.5%-tile is the same as the previous case. The median and 97.5%-tile are approximately equal, both being approximately 1 unit larger than the median curve in the previous case. The expected output pattern for this normal mixture is a truncated normal(4,1) distribution at the 2.5 % uncertainty, a truncated normal(8,1) distribution at the 50 % uncertainty, and a truncated normal(8,1) distribution at the 97.5 % uncertainty. (The median of 4, 8, 8, and 8 equals 8). The simulation results match this pattern.

ix. Calculation Set 2, Case c: For these calculations, 17 CPIEM runs with normal distributions are performed with means having values 3, 3.5, 4, ... ,11, each with standard deviation equal to 1. As in case a) of this set, all the simulations have the same random number seed, and the curves rise in parallel. The results are shown in Figure D-17. Here the median curve is about 4 units to the right of the 2.5%-tile line and 4 units to the left of the 97.5%-tile line. This is as expected because the median of the 17 mean values equals 7, the 2.5[th] percentile is 3, and the 97.5[th] percentile is 11.

14:50 02/22 2002

Set 2, Case a --- Testing 1-2 Module
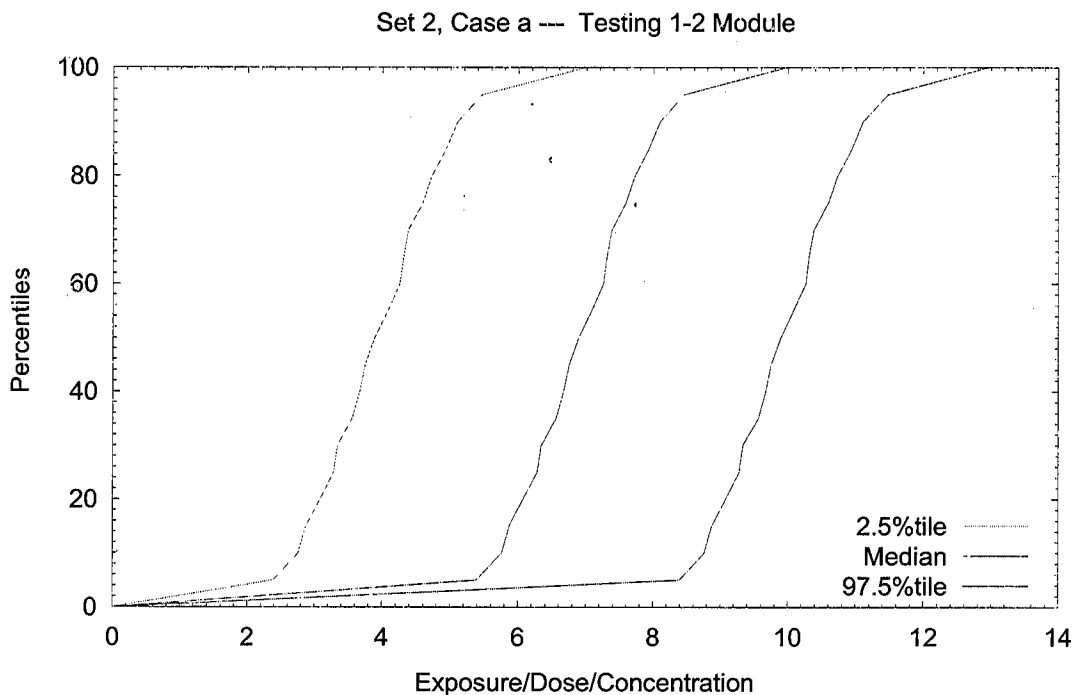
Figure D-15 Results for Set 2, Case a: Four Normal Distributions of (4,1), (6,1), (8,1) and (10,1)

15:01 02/22 2002

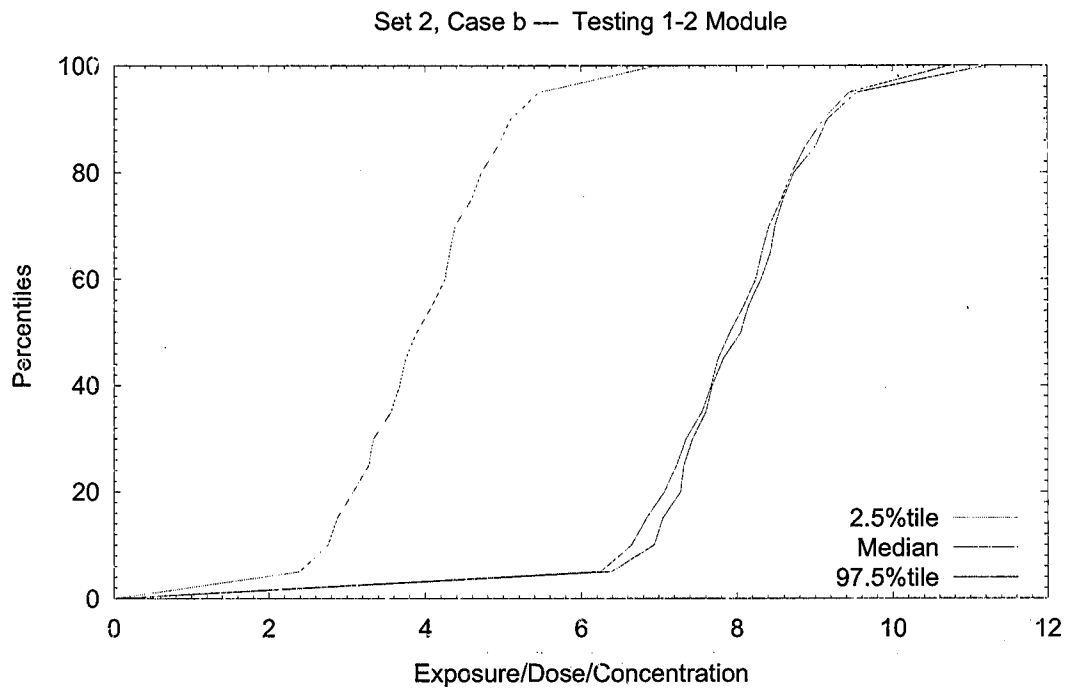Set 2, Case b — Testing 1-2 Module

Figure D-16 Results for Set 2, Case b: Four Normal Distributions of (4,1), (8,1), (8,1) and (8,1)

12:21 03/05 2002

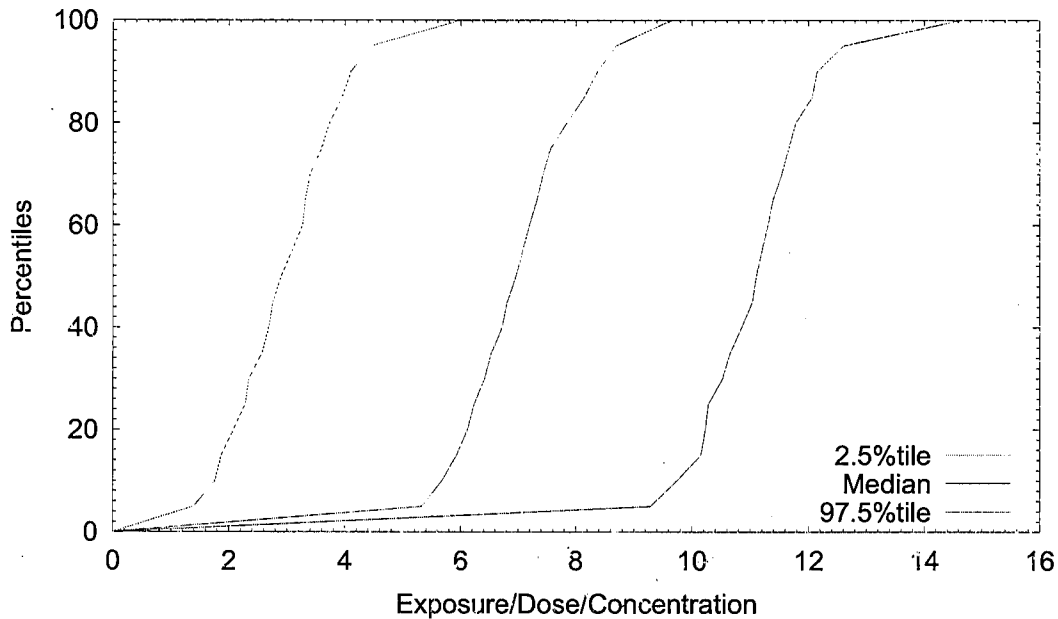**Set 2, Case c --- Testing 1-2 Module (Total Concentration)**

Figure D-17 Results for Set 2, Case c: Seventeen Normal Distributions of (3,1), (3.5,1),
(4,1), ..., (11,1)

Table D-1 contains the 2.5^{th}, 50th, and 97.5^{th} uncertainty percentiles for the arithmetic mean, 25th, 50th, and 75th percentiles of the variability distribution for each of the nine cases described above (corresponding to Figures D-9 to D-17). These uncertainty distributions are given in the columns headed "CPIEM Simulations." Also shown are the corresponding "exact" results based on a more extensive simulation using SAS statistical software-under the columns headed "SAS Simulations." For the SAS simulations in Set 1, 1000 vectors of uncertainty parameters were generated in each case (instead of 20), and each variability distribution was simulated 1,000 times. For the SAS simulations in Set 2, the number of uncertainty simulations was the same as for the CPIEM runs, but each variability distribution was simulated 1,000 times. (For the CPIEM runs, in effect only about 200 values were selected from each distribution because on the average about 95 % of the trials were given zero weight). The SAS results are much closer to the theoretical results corresponding to the limiting case of infinitely many simulations. The strong agreement between the SAS and CPIEM results confirms the model verification.

Set	Summary Statistic	SAS simulations			CPIEM simulations		
		2.5th	50th	97.5th	2.5th	50th	97.5th
1a	Mean	1.94	2.00	2.07	1.84	2.00	2.16
1a	25%	1.25	1.30	1.35	1.21	1.30	1.42
1a	50%	1.73	1.79	1.85	1.59	1.77	1.97
1a	75%	2.37	2.46	2.56	2.20	2.49	2.84
1b	Mean	1.91	2.00	2.09	1.86	1.97	2.21
1b	25%	1.23	1.30	1.38	1.16	1.29	1.45
1b	50%	1.70	1.79	1.88	1.66	1.77	1.98
1b	75%	2.34	2.46	2.59	2.29	2.43	2.89
1c	Mean	1.47	1.96	2.68	1.74	2.07	2.57
1c	25%	0.95	1.33	1.85	1.08	1.41	1.66
1c	50%	1.33	1.78	2.38	1.61	1.89	2.32
1c	75%	1.76	2.38	3.33	2.15	2.59	3.28
1d	Mean	0.11	2.04	3.90	0.10	2.08	4.01
1d	25%	0.00	1.34	3.18	0.00	1.35	3.26
1d	50%	0.02	1.84	3.77	0.01	1.79	3.80
1d	75%	0.07	2.51	4.47	0.04	2.55	4.76
1e	Mean	0.11	2.04	3.90	0.16	2.11	3.88
1e	25%	0.00	1.34	3.18	0.00	1.41	3.13
1e	50%	0.02	1.84	3.77	0.01	1.93	3.73
1e	75%	0.07	2.51	4.47	0.06	2.63	4.59
1f	Mean	0.35	2.02	4.00	0.31	2.01	4.10
1f	25%	0.05	1.31	3.46	0.04	1.22	3.23
1f	50%	0.13	1.77	3.91	0.10	1.87	3.84
1f	75%	0.36	2.43	4.60	0.35	2.66	4.95
2a	Mean	4.01	7.07	10.01	3.91	6.91	9.91
2a	25%	3.32	6.38	9.35	3.28	6.28	9.28
2a	50%	4.02	7.08	10.01	3.89	6.89	9.89
2a	75%	4.69	7.76	10.64	4.59	7.59	10.59
2b	Mean	4.00	7.98	8.04	3.91	7.90	7.97
2b	25%	3.38	7.30	7.31	3.28	7.23	7.32
2b	50%	4.00	7.93	8.04	3.89	7.91	8.05
2b	75%	4.65	8.66	8.73	4.59	8.57	8.59
2c	Mean	3.02	6.98	11.02	2.91	6.96	11.02
2c	25%	2.39	6.34	10.36	2.28	6.23	10.28
2c	50%	3.04	6.95	11.02	2.89	6.96	11.10
2c	75%	3.69	7.69	11.73	3.59	7.56	11.66

Table D-1 Uncertainty Distributions of Selected Summary Statistics

Validation Test

A validation exercise was performed for the original version of CPIEM, using both the Level 1-2 and Level 3 modules, to simulate for daily average benzo(a)pyrene in Riverside residences and compared to values measured as part of the 1990 PTEAM study (Koontz et al. 1998). This validation exercise was repeated using the revised version of CPIEM and the UNC module to account for uncertainties in the model inputs. The findings showed that the PTEAM measurements were all within the CPIEM/UNC predicted uncertainty intervals except at the 90th percentile level.

Calculations were made of the distribution of indoor 24-hour concentrations for benzo(a)pyrene. A total of 20 different calculations were made involving a multi-dimensional matrix where 12 different parameters were varied. The development and rationale of the model was discussed in the Koontz report (Section 7.2.2). The starting values for the model parameters were given in Table 7-11 of the report and are reproduced here as Table D-2.

UNC used the default uncertainty option to calculate the matrix of input values. Thus from each input lognormal distribution, a sample was selected at random and the arithmetic mean and variance parameters were computed from the sample. In order for UNC to calculate default uncertainty distributions, the user must provide the size of the sample along with the parameters of the distribution for the input variables. For this analysis the assumed sample sizes were 100 for the indoor source emission rate, 36 for the ambient concentration, and 10 each for the air-exchange rate and each of the contributing indoor volume distributions (3 of these). Apart from the ambient concentration distribution, these sample sizes are estimates, because the actual sample size values were not reported in Koontz et al. and the original PTEAM data were not readily available. No uncertainty was assumed for the number of indoor sources or for the penetration factor. There are 6 different lognormal distributions and UNC provided 20 sets of arithmetic means and standard deviations for each of these.

The mean of the summary statistics for the resulting distributions are similar to those found for the original CPIEM exercise (see Table D-3). The majority of the calculations gave very small concentrations (less than 1.0 ng/m^3), but there are a few that have a relatively large magnitude concentration. For the 1000 trials each, the calculations gave maximum values that extended from 15 to 66 ng/m^3. Figure 6-1, a plot obtained using UNC showing the uncertainty distribution for the daily concentration distribution, is dominated by this maximum value.

A numerical comparison of the summary statistics from the PTEAM study with the uncertainty intervals is also presented in Table D-3. Except for the 90th percentile and the standard deviation, all of the PTEAM summary statistics lie within the 95 % uncertainty interval from the 2.5th to the 97.5th uncertainty percentile.

The discrepancy at the upper end of the distribution may be the result of overestimating the unknown sample sizes for the emission rate, the air exchange rate, and/or the building volume inputs to UNC. If the sample sizes were assumed to be smaller, the uncertainty ranges would have been larger, and might have encompassed the measured value at the upper end of the distribution and the observed standard deviation. Another possible cause of the discrepancy is the assumption of no uncertainty for the penetration factor or the number of indoor sources. Accounting for uncertainty in either of these variables would also increase the uncertainty range, and possibly result in a wide enough range to encompass the measured data.

A third possibility is that the default uncertainty calculation underestimates the total uncertainty. As noted in section 4, the default uncertainty option accounts for uncertainty attributable to sampling variability only, i.e., uncertainty of the parameters for the distribution due to the fact that the specified distribution is based on observations of only a subset of the entire population of interest. Other types of uncertainty that would not be reflected in the default uncertainty distributions include uncertainty about the correct distributional form, uncertainty about the representativeness of the population from which the samples were taken (i.e., proper sampling frame), and uncertainty about the randomness of the sampling procedure. As is the case for any continuous distribution derived from relatively sparse data, the correct distributional forms of all the variables input to UNC are somewhat uncertain. In particular, Koontz et al. assumed that the emission source strength was lognormally distributed because comparison of the arithmetic mean and the range suggested a very skewed distribution. However, they did not have direct information about the standard deviation of the data set. Uncertainty about the distributional form of a highly skewed distribution is likely to be most influential at the upper end of the distribution, which is where our analysis showed a discrepancy. In addition for this analysis there is uncertainty about the sampling frame for the building volumes, since they were derived from studies other than the PTEAM study, from which the observed concentrations were taken.

Input Parameter	Distribution/Value
Percent of Residences with Indoor Sources	28
Number of Indoor Sources	Normal (1,0)[a]
Emission Rate, ng/h	Lognormal (390, 1285)
Outdoor Concentration, ng/m^3	Lognormal (0.30, 0.36)
Penetration Factor	Normal (0.6, 0)
Indoor Sink, 1/h	Normal (0,0)
Indoor Volume, m^3 • TEAM Study[b] • SoCal Study • ADM Study	 Lognormal (274.9, 110.6) Lognormal (309.5, 159.8) Lognormal (354, 101)
Air Exchange Rate, 1/h	Lognormal (1.25, 1.02)

[a] *Values in parentheses are the mean and standard deviation of the distribution*

[b] *Inputs for volume from three different studies in Southern California were equally weighted*

Table D-2 Summary of Model Inputs for Benzo(a)pyrene (after Koontz et al. 1998, table 7-11)
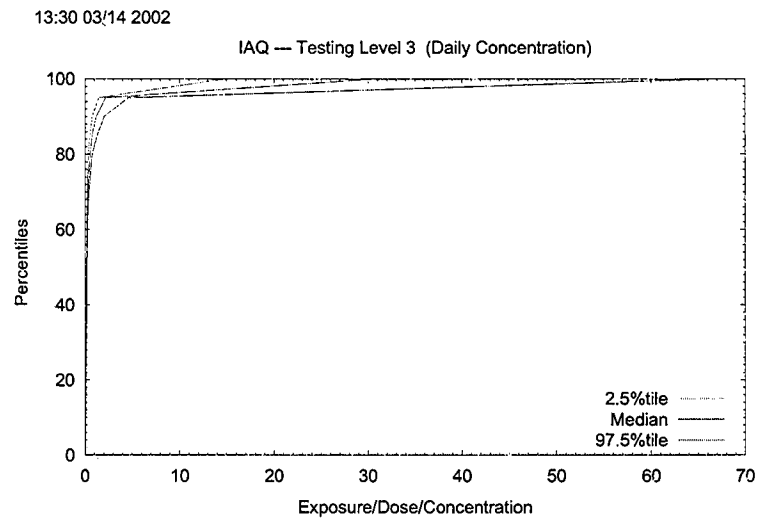
13:30 03/14 2002

Figure D-18 Plot generated by UNC that shows variation in the distribution calculated by CPIEM

Statistic	PTEAM Study	Original CPIEM[a]	Uncertainty Distributions from CPIEM and UNC						
			Mean	Std Dev	Median	2.50%	97.50%	Minimum	Maximum
Arith Mean	0.70	0.68	0.67	0.21	0.63	0.43	1.05	0.43	1.05
Arith Std Dev	4.00	2.17	2.26	0.97	1.97	1.13	3.76	1.13	3.76
Geo Mean			0.20	0.03	0.2	0.16	0.27	0.16	0.27
Geo Std Dev			3.82	0.68	3.64	3.05	5.27	3.05	5.27
Minimum		0.02	0.01	0.01	0.01	0.00	0.02	0.00	0.02
Maximum		17.6	34.1	15.3	30.5	14.7	66.2	14.7	66.2
5%			0.03	0.01	0.03	0.01	0.06	0.01	0.06
10%	NQ[b]	0.04	0.04	0.01	0.04	0.02	0.08	0.02	0.08
15%			0.06	0.02	0.05	0.03	0.09	0.03	0.09
20%			0.07	0.02	0.06	0.04	0.10	0.04	0.10
25%	0.08	0.08	0.08	0.02	0.07	0.05	0.12	0.05	0.12
30%			0.09	0.02	0.09	0.07	0.13	0.07	0.13
35%			0.11	0.02	0.11	0.09	0.15	0.09	0.15
40%			0.13	0.02	0.13	0.10	0.18	0.10	0.18
45%			0.15	0.02	0.15	0.12	0.20	0.12	0.20
50%	0.19	0.15	0.17	0.02	0.17	0.13	0.22	0.13	0.22
55%			0.20	0.03	0.20	0.16	0.25	0.16	0.25
60%			0.23	0.03	0.23	0.18	0.28	0.18	0.28
65%			0.27	0.04	0.27	0.21	0.34	0.21	0.34
70%			0.33	0.06	0.33	0.25	0.44	0.25	0.44
75%	0.36	0.36	0.42	0.08	0.41	0.29	0.55	0.29	0.55
80%			0.54	0.13	0.53	0.35	0.76	0.35	0.76
85%			0.78	0.22	0.74	0.49	1.25	0.49	1.25
90%	0.65	1.15	1.25	0.4	1.15	0.74	2.02	0.74	2.02
95%			2.51	0.95	2.16	1.42	4.58	1.42	4.58
100%			34.14	15.25	30.53	14.74	66.21	14.74	66.21

a Averages across 10 model runs with different random number seeds

b Not quantifiable

Table D-3 Model validation with CPIEM2.0 and UNC

Example

In this section we shall present a simple example application using UNC applied to the same situation as used in the previous Validation section. One of the goals in providing this example is for the user to be able to check their model outputs against the Users Guide. Therefore, the default uncertainty simulations are not suitable for this example because the results depend upon the random seed that cannot be selected by the user for the UNC program. Instead, some reproducible results are developed using the continuous and case name uncertainty options.

In this example the UNC module is used to develop uncertainty estimates for the benzo(a)pyrene indoor concentrations using the same basic CPIEM inputs as in Table D-2 above. All the input distributions are assumed to be known except for the emission rate and indoor volume distributions.

For the emission rate, the distribution is assumed to be lognormal with an uncertain mean but a fixed standard deviation of 1285 ng/h. The mean parameter of the lognormal distribution is assumed to have an uncertainty distribution that is normal, with a mean of 390 ng/h and a standard deviation of 50 ng/h. Since UNC requires all rather than some of the distribution parameters to be assigned uncertainty distributions, the standard deviation parameter of the lognormal distribution is assigned an uncertainty distribution that is uniform, with a minimum of 1285 ng/h and a maximum of 1285 ng/h; this is equivalent to assuming a known value of 1285.

For the indoor volume, instead of giving equal weights to the TEAM, SoCAL, and ADM study lognormal distributions, the volume distribution is assumed to be uncertain so that the TEAM, SoCAL, and ADM distributions are regarded as being equally likely. The difference between these two approaches is that for the original analysis, with assigned weights, the three volume distributions are assumed to each apply to one third of California residences, whereas for this example analysis only one of the volume distributions applies to all California residences, but that selected distribution is equally likely to be from any of the three studies.

Figures D-19, D-20, D-21 and D-22 show how these uncertainty distributions are input to UNC. Figure D-19 shows the initial screen requesting two input factors with uncertainty. After pressing OK, the screen shown in Figure D-20 is to be filled in to specify that the emission factor has an arithmetic lognormal distribution with continuous uncertainty and the volume has case name uncertainty (the distribution for the volume is arbitrarily chosen to be arithmetic lognormal for this example although that information is not used by UNC). After completing the screen shown in Figure D-20 and pressing the OK button, the continuous uncertainty input screen will appear and should be filled out as in Figure D-21. The Figure D-21 inputs specify that the mean of the emission rate distribution is assumed to be normal, with mean = 390 and standard deviation = 50 and that the standard deviation of the emission rate distribution is uniform from 1285 to 1285. After completing the screen shown in Figure D-21 and pressing the OK button, the case name uncertainty input screen will appear and should be filled out as in Figure D-22, which assigns the three case name TEAM, SoCAL, and ADM equal probabilities. Finally, the user should press the OK button to reach a screen that again looks like Figure D-19, and then press the OK button to store the UNC inputs. The user should now use the Input Uncertainty Data menu Save As option to save this input file for future use under the name valid.udt.
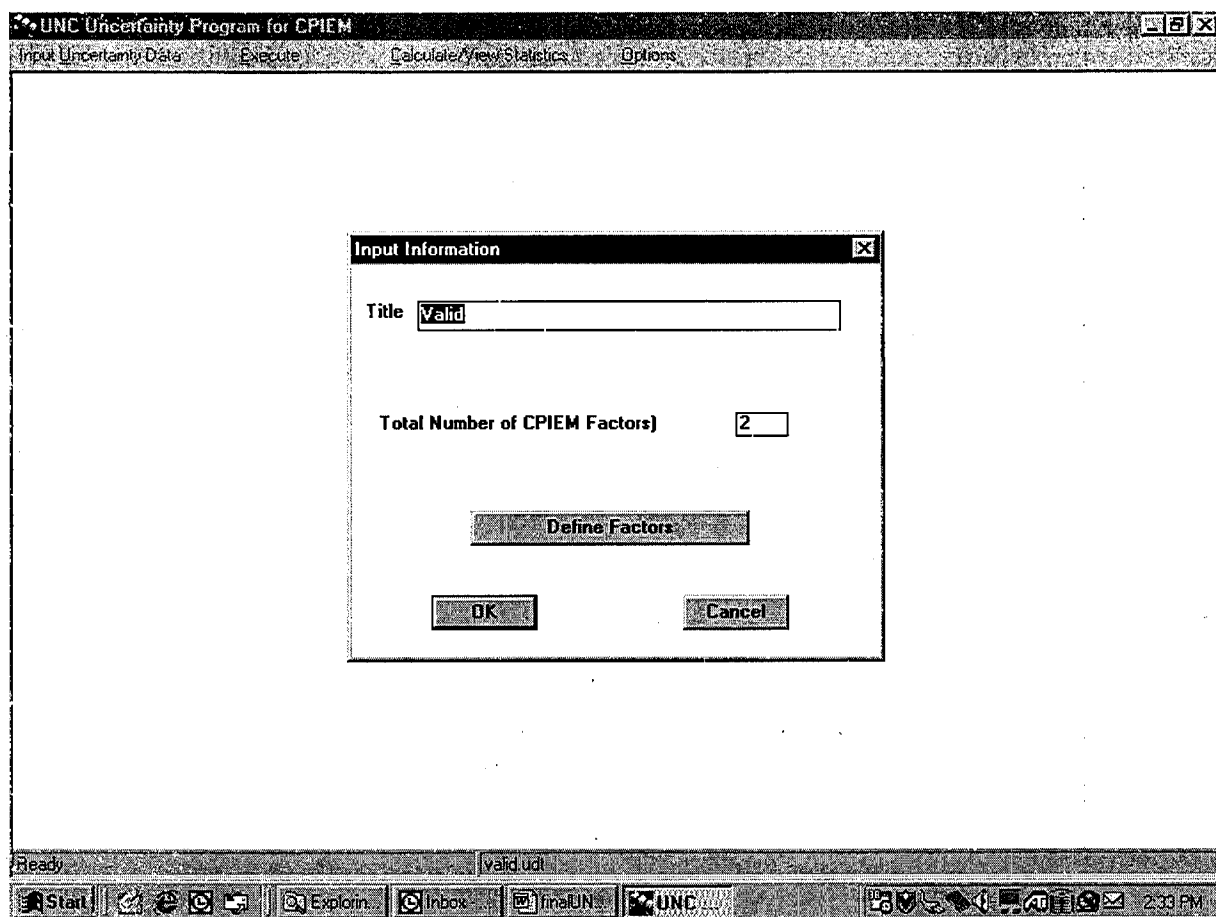
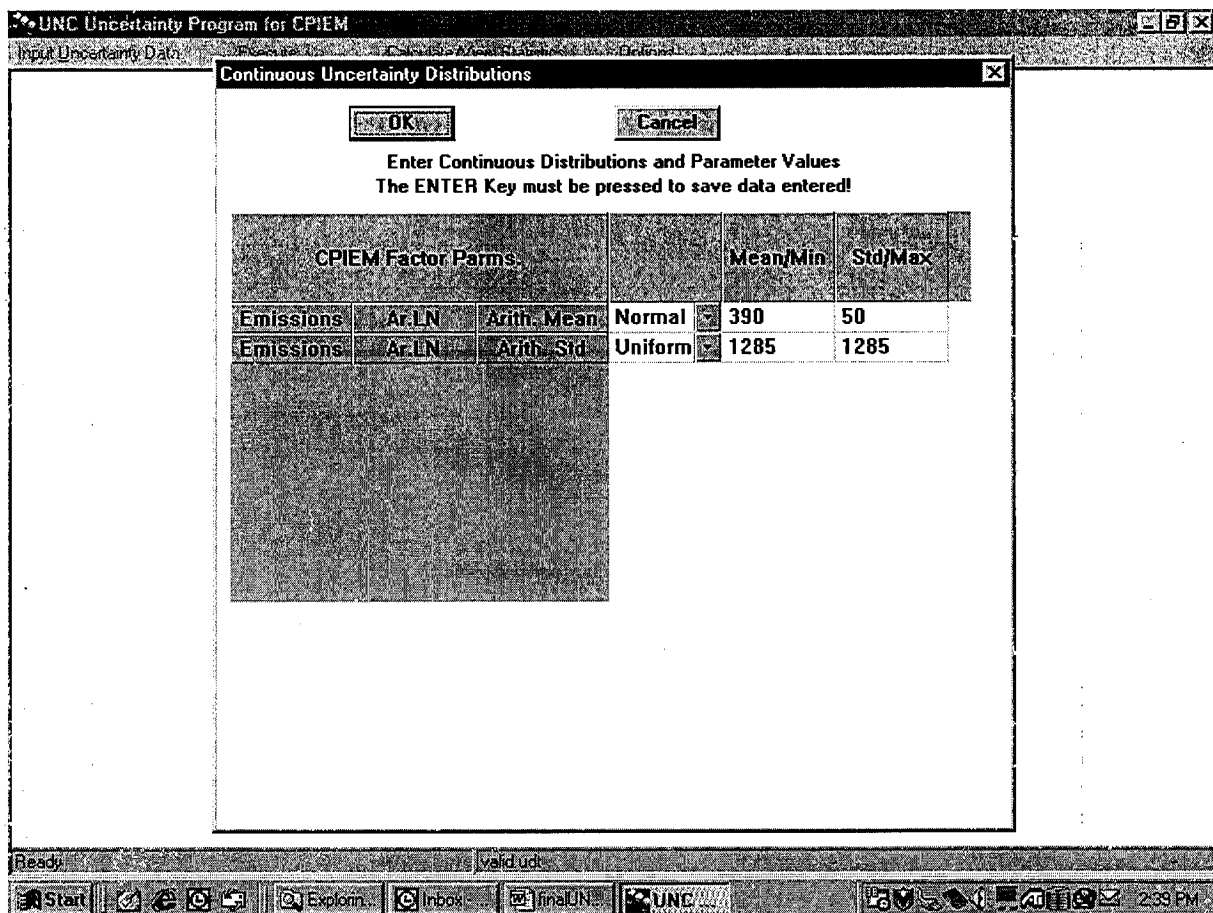**Figure D-19 UNC Input Summary Screen for Benzo(a)pyrene Example**

Figure D-20 UNC Uncertainty Distributions Summary Screen for Benzo(a)pyren Example

Figure D-21 UNC Continuous Uncertainty Distributions Screen for Benzo(a)pyren Example
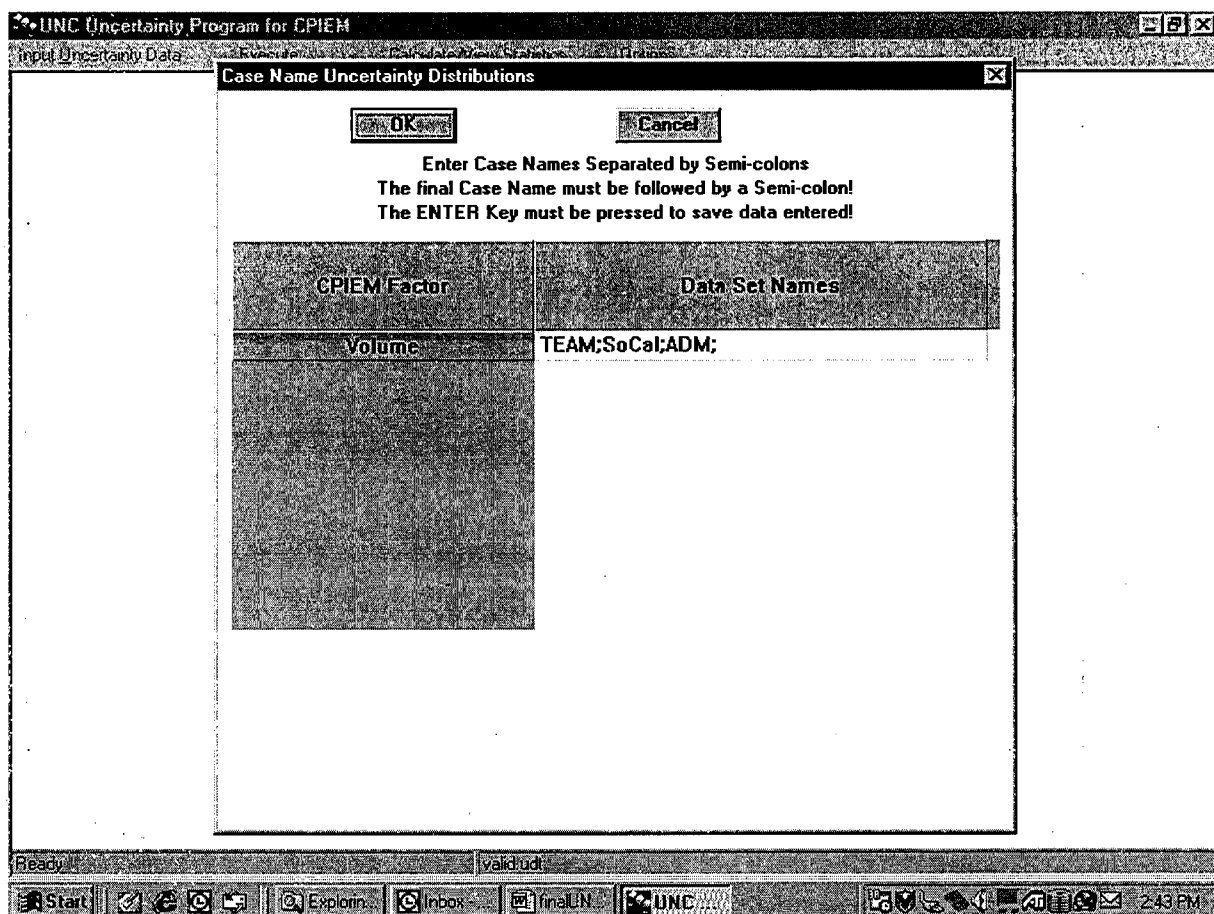
Figure D-22 UNC Case Name Uncertainty Distributions Screen for Benzo(a)pyrene Example

The user can now execute the UNC model to create the uncertainty inputs for CPIEM. To do this, the Execute menu should be selected followed by the Create Uncertainty File submenu For this example, the user should request 6 simulations and should check the Use Midpoint option for the Latin Hypersquare sampling, as shown in Figure D-23.
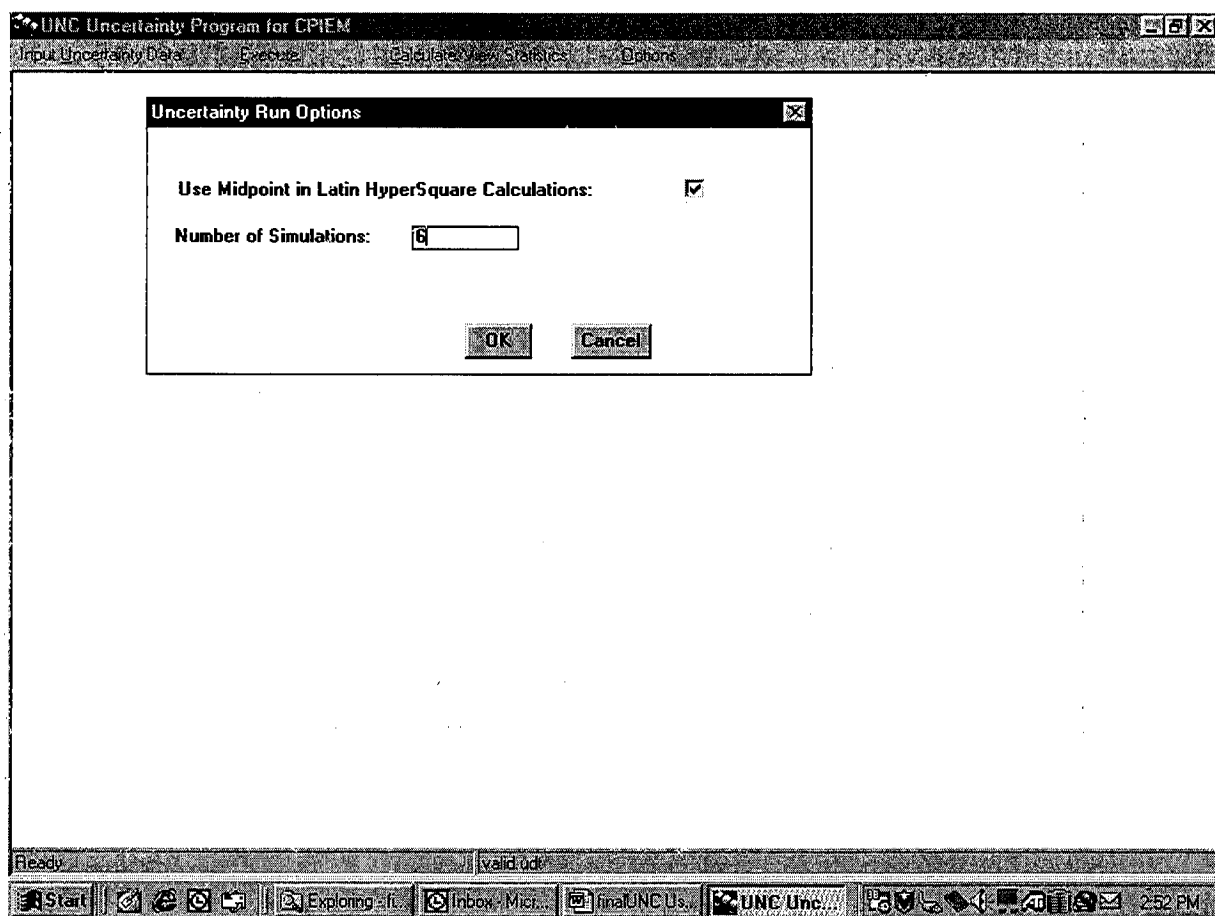

Figure D-23 UNC Uncertainty Run Options Screen for Benzo(a)pyrene Example

After pressing the OK button, the UNC module computes the CPIEM uncertainty inputs and displays them as an ASCII file valid.out as shown in Figure D-24.

```
Parameter;Distribution;Sim 1;Sim 2;Sim 3;Sim 4;Sim 5;Sim 6;

Emissions;Ar.LN;(320.9,1285);(459.1,1285);(379.5,1285);(356.3,1285);(400.5,12
85);(423.7,1285);The distribution for the mean parameter of the Ar.LN
distribution for Cpiem Factor Emissions is poorly specified. The uncertainty
distribution was truncated by 3.09535e-013% to avoid generation of impossible
values.;
Volume;Case Name;(TEAM);(ADM);(SoCal);(ADM);(TEAM);(SoCal);
```

Note that the users' output file will almost certainly NOT look exactly like this because the randomly selected inputs will be rearranged.

Figure D-24 UNC Output File Valid.Out for Benzo(a)pyrene Example

Since the random seed cannot be selected the user, the output file from running this application is unlikely to look exactly like Figure D-24. Instead the six pairs (320.9, 1285), (459.1, 1285), etc. will probably appear in a different order (the numbers will be the same because the Use Midpoint option was selected) and the six case names (TEAM), (ADM), etc. will probably appear in a different order.

Figure D-24 shows that for the first CPIEM simulation (Sim 1) the emission rate parameters are (320.9, 1285) and the volume distribution is from the TEAM study. For the second simulation, the emission rate parameters are (459.1, 1285) and the volume distribution is from the ADM study. And so on. It may be easier to display the CPIEM inputs by copying the valid.out file into Excel as a semicolon delimited file and then using the Copy and Paste Special, Transpose options to transpose the file. This produces the Excel file shown in Figure D-25 (the warning message row has been deleted).

Parameter Distribution	Emissions Ar.LN	Volume Case Name
Sim 1	(320.9,1285)	(TEAM)
Sim 2	(459.1,1285)	(ADM)
Sim 3	(379.5,1285)	(SoCal)
Sim 4	(356.3,1285)	(ADM)
Sim 5	(400.5,1285)	(TEAM)
Sim 6	(423.7,1285)	(SoCal)

Note that the users' output file will almost certainly NOT look exactly like this because the randomly selected inputs will be rearranged.

Figure D-25 Transposed UNC Output File Valid.xls for Benzo(a)pyrene Example

These 6 sets of inputs were then entered into the CPIEM model to give six simulations of 100 trials each using the CPIEM random seed 8740. The other factor inputs are exactly as in Table D-2, which corresponds to the CPIEM example "6.2.1" For example, for the first simulation, the CPIEM example 6.2.1 was modified so that the initial emission rate distribution had mean 320.9 instead of 390 (the standard deviation is unchanged) and so that the selected volume

distribution is from the TEAM study only (i.e., lognormal(274.9, 110.6)) and not an equally weighted mixture of the three studies. The output summary statistics file 6.2.1.stc was renamed as 6.2.1.1.sta. After the six CPIEM runs defined in Figure D-25 were completed, the six sta files were concatenated using the DOS command

Copy *.sta all.sta

Finally, the UNC module was rerun to generate the uncertainty distributions. The Calculate/View Statistics menu with the Select CPIEM Uncertainty Output submenu was used to select the all.sta concatenated statistics file that produced the output uncertainty summary table shown in Table D-4. For example, the arithmetic mean has an uncertainty interval from 0.53 to 0.68, with a mean value of 0.62.

Summary Statistics for: 6.2.1

Daily Average Concentration

Statistic	Mean	Std Dev	Median	2.5 %	97.5 %	Minimum	Maximum
Arith Mean	0.62	0.06	0.63	0.53	0.68	0.53	0.68
Arith Std Dev	1.30	0.13	1.30	1.12	1.47	1.12	1.47
Geo Mean	0.20	0.01	0.20	0.19	0.21	0.19	0.21
Geo Std Dev	3.95	0.17	3.98	3.69	4.13	3.69	4.13
Minimum	0.02	0.00	0.02	0.02	0.02	0.02	0.02
Maximum	7.91	0.85	7.95	6.56	8.85	6.56	8.85
5%	0.03	0.00	0.03	0.03	0.03	0.03	0.03
10%	0.04	0.00	0.04	0.04	0.04	0.04	0.04
15%	0.05	0.00	0.05	0.05	0.05	0.05	0.05
20%	0.06	0.00	0.06	0.06	0.06	0.06	0.06
25%	0.08	0.00	0.08	0.08	0.08	0.08	0.08
30%	0.09	0.00	0.09	0.09	0.09	0.09	0.09
35%	0.11	0.00	0.11	0.11	0.11	0.11	0.11
40%	0.13	0.00	0.13	0.13	0.13	0.13	0.13
45%	0.15	0.00	0.15	0.15	0.15	0.15	0.15
50%	0.17	0.00	0.17	0.17	0.17	0.17	0.17
55%	0.18	0.00	0.18	0.18	0.18	0.18	0.18
60%	0.22	0.00	0.22	0.22	0.22	0.22	0.22
65%	0.25	0.00	0.25	0.25	0.26	0.25	0.26
70%	0.31	0.01	0.31	0.30	0.31	0.30	0.31
75%	0.38	0.02	0.39	0.35	0.40	0.35	0.40
80%	0.49	0.04	0.49	0.45	0.53	0.45	0.53
85%	0.87	0.12	0.93	0.68	0.96	0.68	0.96
90%	1.33	0.21	1.40	1.04	1.58	1.04	1.58
95%	3.45	0.38	3.53	2.82	3.83	2.82	3.83
100%	7.91	0.85	7.95	6.56	8.85	6.56	8.85

Table D-4. Output Uncertainty Distributions from CPIEM and UNC for Benzo(a)pyrene Example.